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METEOROLOGY.—*On the variation of the average daily temperature at Washington, D. C.* RICHMOND T. ZOCH.

The long-period averages of temperature, the "normals," have been computed for Washington by numerous persons since continuous records were made here. The object of having a normal daily temperature is to make an estimate of the temperature for each day. The temperature on the same day for different years varies considerably; and as no paper has been published showing how variable this daily temperature can be, this paper has been prepared.

The standard deviations and the extremes for each day of the year, derived from a 60-year period of record, have been computed and are shown in a table.

Finally, it is pointed out that while there is no diurnal variation in the normal daily temperature, there is a definite diurnal variation in the standard deviation of the average daily temperature, and this has a bearing on the long standing question of the reality of singularities.

COMPUTING THE STANDARD DEVIATION

One of the most obvious facts of meteorology is that there is a diurnal variation in the temperature of the air. Another obvious fact is that there is an annual variation in the air temperature; this latter variation is usually referred to as the annual march of temperature. In making studies of the nature of the annual variation it is sometimes useful and convenient first to eliminate the diurnal variation. In the past, this has been done most often by taking the daily maximum and daily minimum temperatures, adding them together and dividing their sum by two. This is the method used by C. F. Marvin when he compiled Monthly Weather Review Supplement No. 25, which contains daily normal temperatures for each of the principal cities in the United States including Washington. Other methods of computing the average daily temperature have also been used and the reader who is interested in them should refer to Bulletin S of the U. S. Weather Bureau. The method used in this study was to take the twenty-four hourly readings of the temperature for each day, add them and divide the sum by 24.

The temperature observations used in this study were all made by the U. S. Weather Bureau at its central office located on the southwest corner of twenty fourth and M Streets, N.W. A continuous record of temperature has been maintained there since March 1889 by means of a thermograph, and this thermograph has been regularly checked with standard as well as maximum and minimum thermometers. From the thermograph traces hourly readings of temperature have been extracted. The Weather Bureau computed daily averages from the 24 hourly readings from the beginning of this record through 1942. The averages for the years 1943 through (March) 1949 were specially computed for this study.

It is worth pointing out that the record of temperature at twenty fourth and M Streets, N.W., maintained by the Weather Bureau is the longest record of temperature for any location in the District of Columbia. The record used for this study was exactly 60 years (to the nearest whole day) and commenced with the day after the vernal equinox in 1889 and ended on the day of the vernal equinox in 1949, and this period comprises 21,914 days. The date of the vernal equinox in both 1889 and 1949 was March 20 although prior to 1900 it was most

often March 20, and after 1900 it was usually on March 21.

The average temperature for these 21,914 days was arranged into 366 arrays, one array for each day, the arrays so placed that both the vernal equinox and the autumnal equinox of each year were always in the same array. These two days are near the times of the year when the annual march of temperature is rising or falling most rapidly, respectively. As the time from the vernal equinox to the autumnal equinox during these years was approximately 186 days 10 hours and from the autumnal equinox to the vernal equinox approximately 178 days 20 hours, there were 186 arrays with 60 days each beginning with the vernal equinox prior to the autumanl equinox and 178 arrays with 60 days each beginning with the autumnal equinox prior to the vernal equinox. These 364 arrays thus accounted for 21,840 days. The remaining 74 days were placed in two arrays, one about January 20 with 49 days and the other about July 22 with 25 days.

After the average daily temperatures were placed in these 366 arrays several statistical parameters were obtained for each array. First the arithmetic mean was computed for each array, and secondly the standard deviation. Next, a frequency distribution for each array was made and the extremes (lowest average daily temperature and highest average daily temperature, *not* the absolute maximum and absolute minimum), the upper and lower quartiles and the median of each array were obtained. Table 1 shows these standard deviations and extremes. The arithmetic means, quartiles, and medians are not given in this paper.

Table 2 summarizes, or smoothes, the data shown in Table 1. Here the day to day fluctuations are ironed out and one can see at a glance how the standard deviations and extremes of the average daily temperatures change during the year. Table 2 also shows the smoothed averages of the daily arithmetic means which were omitted from Table 1. The standard deviation is greatest in winter and least in summer. Table 2 is intended only to show roughly the annual variation.

THE DIURNAL VARIATION OF THE STANDARD DEVIATION

The question naturally arises, in making these analyses of temperature, when is the best, or most logical, time to begin the "day," the 24-hour period. No answer is given to this question in this article but a few comparisons were made and the results of these will be shown.

The U. S. Weather Bureau, in computing the average daily temperature from the 24 hourly readings, quite naturally used the civil day, when the end of one "day" and the beginning of the next occurs at midnight. There is no *a priori* reason for assuming this to be the most logical time. The most careful or thorough way to investigate this would be to begin the "day" with each one of the 24 hours. Then, instead of having 21,914 average daily temperatures for this 60 year period of record there would be 24 times 21,914 or 525,936 average daily temperatures to be placed in 24 sets of 366 arrays and then 24 sets of 366 arithmetic means, standard deviations, extremes, quartiles and medians to be computed or derived. Clearly, to do this task in such a thorough manner is a machine job, and it was not possible for the present writer to undertake it. To make some investigation it was decided to use a "day" for which the end of one 24-hour period and the beginning of the next occurs at noon. This additional investigation would mean one additional set of 366 arrays, and to proceed it would first be necessary to compute 21,914 new average daily temperatures. Even this was too large an undertaking by hand methods so this investigation was confined to a 31-day period, the 31 days following the vernal equinox.

First, 1860 average daily temperatures were computed where the end of one 24-hour period and the beginning of the next was at noon. Then these 1860 average daily temperatures were arranged into 31 arrays with 60 temperatures in each array; finally the arithmetic means and the standard deviations were computed and the extremes obtained for each of these 31 arrays. These results are shown in Tables 3 and 4.

TABLE 1.—STANDARD DEVIATIONS AND EXTREMES FOR EACH DAY OF THE YEAR

Day after vernal equinox	Lowest temperature °F	Year of occurrence	Standard deviation °F	Highest temperature °F	Year of occurrence	Usual calendar date
						Mar.
1	30.4	1914	10.61	74.8	1948	21
2	21.5	1934	10.63	75.6	1948	22
3	23.8	1906	9.17	67.0	1929	23
4	26.0	1940	9.06	71.8	1939	24
5	26.7	1940	9.52	68.7	1939	25
6	29.9	1894	9.76	71.8	1921	26
7	27.0	1894	10.00	74.1	1921	27
8	29.8	1923	9.72	72.1	1907	28
9	34.0	1893	8.94	72.5	1945	29
10	26.2	1923	8.24	70.8	1945	30
11	25.9	1923	8.17	65.6	1945	31
						Apr.
12	31.8	1924	9.18	71.2	1917	1
13	34.9	1911	8.26	69.5	1903	2
14	35.4	1908	8.59	70.7	1913	3
15	35.0	1896	8.98	69.3	1910	4
16	34.1	1944	7.61	74.5	1942	5
17	35.5	1898	8.53	75.0	1942	6
18	38.4	1935	8.40	77.5	1929	7
19	35.1	1916	7.55	76.7	1929	8
20	34.0	1917	8.83	77.6	1922	9
21	34.3	1918	8.79	73.9	1922	10
22	34.9	1894	7.62	72.2	1947	11
23	39.5	1894	7.21	69.6	1948	12
24	34.7	1940	8.05	72.4	1945	13
25	36.8	1923	8.80	74.8	1941	14
26	35.8	1935	8.24	75.1	1941	15
27	38.8	1905	7.71	72.6	1941	16
28	38.6	1926	8.14	73.5	1896	17
29	37.6	1926	8.87	78.4	1896	18
30	41.6	1890	8.72	79.8	1896	19
31	38.0	1897	8.95	80.9	1941	20
32	42.2	1922	8.10	74.9	1896	21
33	42.2	1930	8.12	76.7	1902	22
34	40.9	1930	7.97	71.6	1915	23
35	39.5	1919	7.58	77.2	1925	24
36	44.4	1919	7.41	75.8	1915	25
37	45.8	1892	7.49	76.4	1915	26
38	43.2	1928	7.39	74.7	1938	27
39	37.8	1898	6.69	69.6	1938	28
40	48.3	1925	6.60	74.6	1942	29
41	45.1	1912	7.10	77.5	1942	30
						May
42	47.8	1908	6.86	75.5	1930	1
43	49.5	1911	6.74	76.6	1942	2
44	46.1	1946	7.32	75.2	1919	3
45	46.5	1917	7.32	74.9	1944	4
46	44.2	1917	7.69	75.2	1918	5
47	45.1	1891	8.37	79.2	1930	6
48	46.5	1947	7.12	77.1	1930	7
49	44.5	1947	7.42	77.4	1930	8
50	46.6	1906	7.32	78.9	1936	9
51	47.1	1913	7.28	78.6	1911	10
52	49.0	1907	6.44	81.2	1896	11
53	49.5	1939	7.02	79.2	1896	12
54	50.2	1895	6.59	75.3	1908	13
55	49.7	1895	6.44	77.7	1940	14
56	49.7	1895	7.05	78.1	1900	15
57	49.1	1895	6.40	77.0	1944	16
58	52.1	1891	6.13	79.3	1911	17
59	52.9	1895	6.15	81.8	1911	18
60	54.8	1915	6.03	80.4	1911	19
61	50.3	1929	6.82	78.4	1898	20
62	49.8	1895	6.53	80.8	1911	21
63	52.1	1895	7.54	82.1	1941	22
64	53.4	1889	6.05	80.4	1925	23
65	53.2	1907	6.11	77.9	1946	24
66	47.7	1925	6.06	78.6	1918	25
67	52.7	1925	6.53	78.8	1914	26
68	53.3	1902	6.99	83.9	1941	27
69	55.8	1891	6.68	83.8	1941	28
70	54.6	1915	6.60	79.6	1939	29
71	55.2	1910	6.50	82.6	1895	30
72	52.8	1907	6.40	84.3	1895	31
						June
73	50.8	1907	6.40	85.7	1895	1
74	54.2	1915	6.99	86.7	1895	2
75	54.4	1929	6.63	85.2	1895	3
76	52.7	1926	6.57	84.8	1943	4
77	54.8	1945	6.84	84.7	1925	5
78	51.7	1894	6.83	85.7	1925	6
79	54.7	1891	6.37	84.6	1899	7
80	54.8	1913	6.32	83.6	1899	8
81	57.9	1913	5.96	86.7	1933	9
82	51.8	1907	6.56	85.4	1911	10
83	55.5	1907	6.23	84.9	1947	11
84	55.8	1907	5.90	81.5	1933	12
85	57.7	1907	5.43	80.7	1944	13
86	56.3	1933	5.43	82.9	1945	14
87	58.1	1901	6.08	84.2	1945	15
88	58.9	1917	5.99	84.5	1945	16
89	59.8	1900	5.56	83.8	1945	17
90	62.5	1946	4.80	84.6	1944	18
91	62.9	1912	5.17	85.4	1931	19
92	64.0	1920	5.23	85.2	1924	20
93	61.2	1940	5.26	83.5	1941	21
94	59.7	1918	5.65	84.3	1943	22
95	61.7	1936	5.81	84.0	1914	23
96	57.0	1936	5.69	85.8	1943	24
97	63.0	1918	4.83	85.1	1943	25
98	64.3	1896	4.73	84.7	1943	26
99	62.6	1893	5.13	83.8	1913	27
100	62.8	1919	5.07	87.5	1934	28
101	61.5	1893	5.36	86.0	1945	29
102	67.2	1943	5.16	89.3	1901	30

TABLE 1.—*Continued*

Day after vernal equinox	Lowest temperature °F	Year of occurrence	Standard deviation °F	Highest temperature °F	Year of occurrence	Usual calendar date
						July
103	66.6	1940	5.50	88.0	1933	1
104	65.8	1891	4.66	87.9	1898	2
105	60.9	1933	5.32	88.5	1898	3
106	63.5	1940	5.30	86.2	1911	4
107	66.0	1909	4.74	86.5	1911	5
108	66.2	1892	4.52	86.5	1934	6
109	65.4	1918	4.28	85.7	1925	7
110	60.5	1891	4.81	86.2	1890	8
111	64.2	1891	5.00	87.4	1936	9
112	65.9	1890	4.79	89.9	1936	10
113	63.3	1895	4.79	86.0	1935	11
114	64.7	1898	4.57	85.2	1944	12
115	66.4	1926	4.35	85.2	1942	13
116	62.5	1926	4.73	85.5	1934	14
117	67.2	1903	4.36	84.8	1936	15
118	68.0	1929	3.98	84.3	1942	16
119	65.8	1910	5.04	86.8	1900	17
120	65.8	1892	4.74	88.0	1942	18
121	68.7	1939	4.62	89.9	1930	19
122	65.3	1890	5.20	90.0	1930	20
123	66.3	1890	4.63	87.6	1926	21
124	68.1	1904	3.65	83.2	1899	22

Day before autumnal equinox	Lowest temperature °F	Year of occurrence	Standard deviation °F	Highest temperature °F	Year of occurrence	Usual calendar date
						July
62	67.4	1947	4.20	84.6	1914	23
61	66.4	1912	4.46	84.3	1935	24
60	66.5	1904	4.22	85.0	1930	25
59	64.0	1920	4.95	88.0	1930	26
58	65.5	1920	5.14	88.9	1930	27
57	68.3	1895	4.74	88.0	1940	28
56	67.8	1914	3.98	86.2	1901	29
55	63.0	1914	4.49	85.0	1931	30
54	64.1	1903	5.22	87.5	1917	31
						Aug.
53	66.4	1895	4.70	87.4	1933	1
52	67.2	1920	4.42	84.3	1926	2
51	62.9	1921	4.90	86.3	1931	3
50	64.2	1912	4.68	87.4	1930	4
49	64.1	1912	5.31	88.5	1930	5
48	65.5	1912	4.65	91.3	1918	6
47	66.9	1948	4.75	87.3	1918	7
46	68.6	1942	4.43	87.0	1930	8
45	65.0	1897	4.99	88.0	1930	9
44	67.6	1927	4.05	87.7	1896	10
43	67.1	1931	4.32	86.3	1900	11
42	60.7	1928	5.43	86.7	1926	12
41	65.7	1941	5.70	85.1	1896	13
40	66.4	1902	5.01	86.0	1943	14
39	65.1	1899	4.59	84.7	1938	15
38	66.9	1921	4.14	85.0	1938	16
37	64.2	1923	4.46	83.1	1944	17
36	63.8	1915	4.60	83.0	1944	18
35	65.0	1905	4.12	84.4	1937	19
34	63.0	1926	4.56	85.0	1937	20
33	62.7	1926	4.92	84.0	1937	21
32	62.2	1931	4.98	84.6	1916	22
31	60.5	1931	4.75	84.2	1936	23
30	60.7	1890	5.07	84.4	1903	24
29	59.8	1890	5.38	84.0	1947	25
28	59.2	1908	5.52	84.0	1900	26
27	59.3	1927	5.41	85.1	1948	27
26	60.3	1915	5.42	86.0	1948	28
25	58.7	1891	5.59	86.0	1948	29
24	60.8	1911	5.24	83.2	1948	30
23	61.2	1911	5.50	85.8	1932	31
						Sept.
22	61.4	1890	5.63	86.5	1932	1
21	60.0	1893	5.91	83.2	1898	2
20	61.2	1892	5.76	82.4	1898	3
19	62.7	1893	4.81	83.7	1898	4
18	60.0	1928	4.89	82.1	1944	5
17	57.2	1928	5.88	83.0	1900	6
16	59.2	1924	6.32	82.7	1898	7
15	57.9	1918	5.93	86.2	1939	8
14	57.8	1914	6.20	82.2	1933	9
13	54.7	1924	6.98	83.7	1941	10
12	51.1	1917	6.90	83.7	1900	11
11	56.7	1917	6.08	83.0	1895	12
10	58.2	1911	5.73	81.4	1931	13
9	55.6	1913	6.63	82.6	1915	14
8	56.0	1895	5.57	82.6	1930	15
7	55.8	1923	6.10	79.9	1942	16
6	57.8	1903	6.00	79.2	1915	17
5	56.9	1937	5.89	79.8	1921	18
4	52.6	1916	6.23	80.3	1942	19
3	54.5	1929	6.34	80.7	1895	20
2	51.9	1918	5.19	81.9	1931	21
1	47.4	1904	7.58	84.1	1931	22

TABLE 1.—*Continued*

Day after autumnal equinox	Lowest temperature °F	Year of occurrence	Standard deviation °F	Highest temperature °F	Year of occurrence	Usual calendar date
						Sept.
0	50.0	1904	7.08	82.2	1895	23
1	50.8	1896	6.91	79.0	1926	24
2	51.5	1928	7.00	80.9	1930	25
3	49.7	1928	7.09	82.5	1930	26
4	49.4	1940	7.22	78.7	1900	27
5	50.9	1942	6.92	77.2	1945	28
6	50.1	1942	6.46	76.1	1945	29
7	48.8	1899	6.69	75.8	1927	30
						Oct.
8	44.5	1899	6.72	78.4	1927	1
9	46.4	1899	6.13	76.2	1927	2
10	45.9	1899	6.21	74.2	1941	3
11	49.2	1901	7.51	80.9	1941	4
12	49.8	1901	7.23	82.8	1941	5
13	42.4	1935	7.71	82.5	1941	6
14	43.9	1904	7.78	83.3	1941	7
15	46.1	1889	7.19	76.1	1941	8
16	43.2	1917	7.40	75.5	1939	9
17	41.8	1925	7.82	76.6	1939	10
18	41.5	1906	6.94	74.6	1919	11
19	42.0	1906	6.31	73.6	1912	12
20	43.2	1934	5.82	72.0	1928	13
21	44.5	1934	6.52	69.6	1941	14
22	42.6	1937	6.99	70.2	1915	15
23	43.9	1937	6.92	72.2	1919	16
24	46.3	1900	6.98	74.4	1928	17
25	44.7	1901	6.89	72.8	1928	18
26	44.7	1948	6.77	70.9	1947	19
27	38.5	1940	7.28	70.5	1916	20
28	37.2	1940	7.34	68.6	1941	21
29	41.9	1925	7.48	71.4	1935	22
30	41.2	1907	6.85	70.2	1900	23
31	38.8	1889	6.13	69.5	1900	24
32	41.0	1889	6.53	66.0	1908	25
33	39.9	1933	6.83	67.3	1920	26
34	36.8	1936	7.44	70.5	1920	27
35	40.2	1936	7.17	71.4	1919	28
36	38.1	1925	7.69	72.4	1918	29
37	36.6	1925	7.45	69.8	1946	30
38	34.5	1917	7.91	72.4	1946	31
						Nov.
39	37.9	1893	7.67	67.0	1919	1
40	37.2	1905	8.46	71.8	1929	2
41	36.3	1911	7.68	69.6	1936	3
42	38.1	1910	7.48	67.0	1936	4
43	35.9	1908	6.75	71.2	1935	5
44	35.8	1903	7.02	68.2	1938	6
45	34.0	1930	6.82	71.0	1948	7
46	38.5	1927	6.55	66.3	1943	8
47	37.9	1923	6.98	69.6	1895	9
48	35.2	1933	6.28	58.6	1935	10
49	32.2	1926	7.12	62.8	1935	11
50	33.6	1926	7.76	67.1	1935	12
51	26.4	1911	8.09	62.8	1931	13
52	30.3	1905	7.14	63.6	1929	14
53	27.1	1933	8.22	62.8	1926	15
54	23.8	1933	8.26	64.5	1927	16
55	29.5	1924	8.88	66.0	1930	17
56	26.8	1891	9.71	70.6	1928	18
57	28.4	1936	9.03	66.7	1921	19
58	31.4	1901	8.36	65.8	1931	20
59	30.6	1937	8.60	68.7	1900	21
60	31.0	1929	8.35	63.2	1931	22
61	30.1	1929	7.36	63.7	1940	23
62	29.1	1938	6.85	61.8	1927	24
63	25.8	1903	7.18	57.5	1905	25
64	24.9	1903	8.40	64.4	1946	26
65	24.8	1932	9.01	60.8	1927	27
66	20.1	1930	8.61	66.5	1896	28
67	25.9	1891	8.23	62.0	1896	29
68	18.0	1929	9.27	64.4	1927	30
						Dec.
69	23.8	1936	7.76	62.2	1908	1
70	22.8	1930	7.07	54.9	1921	2
71	23.5	1896	7.51	55.2	1914	3
72	24.4	1896	8.12	53.3	1933	4
73	22.7	1926	8.43	59.7	1916	5
74	22.1	1901	7.29	59.5	1912	6
75	26.5	1893	6.64	56.0	1932	7
76	25.3	1910	6.89	57.1	1924	8
77	21.1	1927	9.12	56.0	1923	9
78	16.0	1917	8.55	55.6	1889	10
79	17.0	1917	8.53	55.0	1899	11
80	20.5	1904	8.55	59.8	1899	12
81	20.7	1895	8.99	58.6	1919	13
82	17.0	1904	9.54	62.7	1901	14
83	15.1	1914	9.04	54.9	1906	15
84	17.8	1916	9.30	51.6	1933	16
85	18.9	1932	7.81	54.5	1928	17
86	12.6	1919	8.80	55.8	1937	18
87	15.2	1919	8.67	57.8	1929	19
88	13.5	1942	7.62	58.2	1895	20
89	14.8	1942	8.74	56.8	1923	21
90	18.4	1924	8.38	53.8	1923	22
91	21.0	1935	8.84	58.7	1891	23
92	18.3	1906	8.96	59.5	1891	24
93	19.2	1892	8.24	59.3	1932	25
94	12.5	1914	9.12	56.2	1895	26
95	14.0	1914	9.07	58.4	1889	27
96	18.9	1892	9.66	55.5	1936	28
97	7.3	1917	9.63	52.0	1910	29
98	2.7	1917	10.12	56.7	1940	30
99	7.2	1917	8.86	56.8	1898	31

TABLE 1.—*Continued*

Day after autumnal equinox	Lowest temperature °F	Year of occurrence	Standard deviation °F	Highest temperature °F	Year of occurrence	Usual calendar date
						Jan.
100	10.9	1918	8.77	57.6	1919	1
101	11.5	1904	9.87	56.6	1930	2
102	10.3	1918	9.31	51.5	1890	3
103	10.8	1904	9.58	51.3	1907	4
104	12.1	1896	10.34	57.2	1897	5
105	11.0	1912	9.89	60.9	1946	6
106	17.8	1912	9.74	62.4	1946	7
107	12.4	1942	8.06	57.5	1930	8
108	19.1	1942	9.74	63.2	1937	9
109	18.9	1942	7.71	54.7	1939	10
110	13.6	1893	8.68	53.6	1913	11
111	12.6	1893	8.26	50.6	1911	12
112	2.2	1912	10.04	65.6	1932	13
113	5.3	1912	11.04	60.2	1932	14
114	13.7	1893	11.05	65.0	1932	15
115	13.5	1912	8.70	56.9	1943	16
116	9.2	1893	9.29	59.5	1913	17
117	21.1	1904	9.94	56.8	1915	18
118	10.7	1893	9.98	56.5	1929	19
119	15.4	1940	8.65	52.6	1949	20

Day before vernal equinox	Lowest temperature °F	Year of occurrence	Standard deviation °F	Highest temperature °F	Year of occurrence	Usual calendar date
						Jan.
59	13.0	1924	9.50	55.6	1890	21
58	16.7	1893	9.11	60.2	1906	22
57	8.5	1936	10.35	59.7	1906	23
56	11.5	1935	10.57	57.5	1933	24
55	14.0	1935	9.58	55.5	1909	25
54	11.7	1897	10.02	55.4	1916	26
53	14.1	1936	11.25	61.3	1916	27
52	12.1	1935	10.97	61.2	1916	28
51	10.2	1925	9.42	53.6	1947	29
50	11.2	1934	10.63	64.5	1947	30
49	15.4	1936	10.07	60.8	1916	31
						Feb.
48	17.9	1936	7.23	48.4	1916	1
47	11.2	1900	8.89	51.5	1891	2
46	11.1	1905	9.58	51.0	1932	3
45	13.3	1905	9.53	54.0	1903	4
44	6.3	1918	9.44	55.4	1890	5
43	8.4	1917	9.92	58.9	1890	6
42	6.8	1895	9.01	55.3	1904	7
41	6.9	1895	8.10	49.2	1932	8
40	3.7	1934	9.72	52.6	1900	9
39	3.0	1899	9.78	53.0	1949	10
38	−3.2	1899	9.47	58.8	1925	11
37	.4	1899	10.04	60.0	1932	12
36	7.5	1899	10.28	54.0	1898	13
35	7.0	1899	10.21	56.0	1949	14
34	12.2	1943	9.98	62.0	1909	15
33	11.8	1904	10.25	65.0	1949	16
32	14.0	1904	9.63	60.2	1927	17
31	13.5	1896	8.36	66.8	1891	18
30	10.2	1903	10.44	59.4	1891	19
29	20.1	1934	9.42	65.9	1939	20
28	12.1	1896	9.27	56.6	1943	21
27	17.1	1896	8.78	57.9	1913	22
26	19.5	1914	8.95	62.0	1922	23
25	11.9	1914	9.11	57.5	1943	24
24	14.5	1914	9.62	68.3	1930	25
23	14.6	1900	9.75	58.7	1930	26
22	12.8	1934	9.70	63.4	1890	27
21	15.8	1934	9.99	62.2	1903	28
20	25.0	1941	7.46	59.8	1910	29
						Mar.
19	20.8	1914	7.24	59.0	1895	1
18	23.0	1891	7.88	64.5	1923	2
17	21.2	1925	9.05	63.9	1923	3
16	23.6	1926	8.40	62.0	1946	4
15	16.1	1901	9.84	63.5	1935	5
14	21.8	1920	9.13	64.9	1946	6
13	21.8	1932	8.80	66.0	1921	7
12	24.5	1932	7.98	68.2	1921	8
11	20.9	1932	7.28	63.7	1921	9
10	23.2	1932	8.02	58.8	1935	10
9	25.6	1914	8.56	63.1	1925	11
8	22.0	1900	9.82	63.8	1890	12
7	25.2	1896	9.01	63.8	1946	13
6	23.6	1896	9.41	65.5	1929	14
5	21.6	1911	9.44	65.1	1935	15
4	23.5	1916	11.46	72.2	1945	16
3	20.8	1900	10.78	69.1	1945	17
2	22.5	1941	9.63	64.5	1945	18
1	26.3	1914	9.66	69.9	1945	19
0	24.4	1914	10.61	73.6	1945	20

Table 3 shows the standard deviations for each array computed first from midnight-to-midnight average daily temperatures and then, in another column, from noon-to-noon temperatures. For the 31-day period considered the mean difference is 0.421° F. It is not believed advisable to apply the usual statistical tests to find out whether this difference is significant because of the strong serial correlation due to the interrelationship between the values. Table 4 shows the extremes for each array derived first from midnight-to-midnight values and then from noon-to-noon values. For this 31-day period

the mean range between lowest and highest for midnight-to-midnight values is 40.1° F., while this range for noon-to-noon values is 40.8° F.

It is concluded that the variability of average daily temperature is greater when these daily averages are based on noon-to-noon values than when determined from midnight-to-midnight values. There is no reason for thinking that the midnight-to-midnight averages of temperature necessarily gives the minimum value for the standard deviation, nor is there any reason for concluding that the standard deviation computed from averages based on beginning and ending the day with noon is the maximum. Further research will be required to determine these maximum and minimum values of the standard deviation. However, the fact that there is a difference between the standard deviations computed from average daily temperatures based on midnight-to-midnight from those based on noon-to-noon demonstrates that maximum and minimum values of this standard deviation of temperature do exist.

Figures 1 and 2 depict the results of Table 3 graphically. Figure 1 shows the arithmetic means for 62 arrays all for the 31-day period following the vernal equinox. Likewise, Figure 2 shows the standard deviations. Figure 1 also shows the fairly well known fact that the annual march of temperature is not perfectly smooth. The high points such as the midnight-to-midnight value of the arithmetic mean (50.32) for the array dated March 26 and the low points such as the noon-to-noon value (47.31) for the array dated March 28 are technically referred to as "singularities" and have long been discussed by meteorologists and climatologists. C. F. Marvin held that these singularities were unreal, i.e., that there was no natural cause for them and that they were entirely the result of random sampling of the data. Other meteorologists have held these singularities to be real. The discussion of the reality of these singularities resolves itself into an

TABLE 2.—SUMMARY OF TABLE 1. MEAN VALUES OF EXTREMES AND STANDARD DEVIATIONS OF AVERAGE DAILY TEMPERATURE BY PERIODS

(Temperatures are in °F.)

Period	Lowest	Highest	Arithmetic mean	Standard deviation	Duration of period, days
Mar. 21–Apr. 20	33.1	73.2	50.9	8.74	31
Apr. 21–May 21	46.8	77.0	61.6	7.08	31
May 22–June 21	55.5	83.4	70.0	6.19	31
June 22–July 22	64.3	86.6	75.9	4.87	30.42
July 23–Aug. 22	65.3	86.1	75.8	4.68	31
Aug. 23–Sept. 22	57.7	83.1	70.9	5.82	31
Sept. 23–Oct. 22	45.5	76.0	60.3	6.98	30
Oct. 23–Nov. 21	34.5	67.7	49.7	7.56	30
Nov. 22–Dec. 21	21.4	58.6	39.2	8.21	30
Dec. 22–Jan. 20	12.8	57.2	35.1	9.31	29.82
Jan. 21–Feb. 19	10.0	57.2	34.2	9.71	30
Feb. 20–Mar. 20	20.5	63.9	40.8	9.14	30

TABLE 3.—COMPARISON OF STANDARD DEVIATIONS COMPUTED FROM MIDNIGHT-TO-MIDNIGHT AVERAGE DAILY TEMPERATURE WITH THOSE FROM NOON TO NOON

Day after vernal equinox	Midnight to midnight		Noon to noon	
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation
1	45.70	10.61	45.71	11.23
2	46.72	10.63	47.43	10.10
3	47.78	9.17	48.35	9.14
4	49.04	9.06	49.12	9.25
5	49.28	9.52	49.89	10.46
6	50.32	9.76	50.00	10.07
7	48.64	10.00	47.94	10.15
8	47.51	9.72	47.31	9.65
9	47.51	8.94	47.54	8.10
10	47.60	8.24	48.24	8.80
11	48.92	8.17	49.88	9.05
12	50.14	9.18	50.00	8.90
13	49.78	8.26	49.55	8.32
14	49.33	8.59	49.52	9.07
15	50.30	8.98	51.06	9.40
16	51.30	7.61	51.90	10.58
17	52.27	8.53	52.29	9.65
18	51.80	8.40	50.60	8.23
19	50.58	7.55	51.00	9.49
20	51.60	8.83	51.94	9.52
21	50.98	8.79	50.17	8.22
22	50.13	7.62	51.02	7.59
23	52.18	7.21	52.38	7.74
24	53.13	8.05	53.87	9.36
25	54.54	8.80	54.34	9.14
26	53.74	8.24	53.36	8.03
27	53.85	7.71	54.13	8.27
28	54.86	8.14	55.43	8.79
29	56.30	8.87	56.93	9.08
30	56.94	8.72	56.60	9.09
31	56.54	8.95	56.66	9.41
Means		8.737		9.158

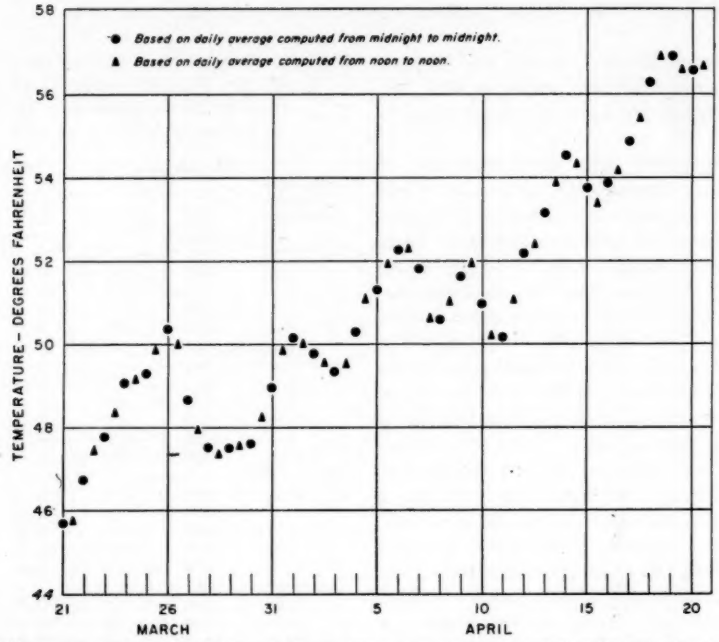

FIG. 1.—Observed average daily temperature: 60 years of record, 1889–1948, Washington, D. C. Twenty-fourth and M Streets, NW.

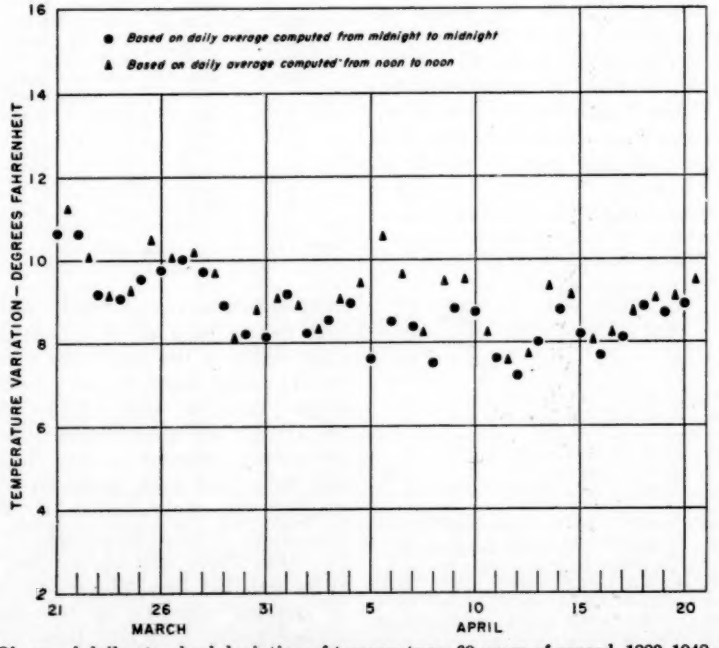

FIG. 2.—Observed daily standard deviation of temperature: 60 years of record, 1889–1948, Washington, D. C., Twenty-fourth and M Streets, NW.

TABLE 4.—COMPARISON OF EXTREMES DERIVED FROM MIDNIGHT-TO-MIDNIGHT AVERAGE DAILY TEMPERATURES WITH THOSE FROM NOON TO NOON

Day after vernal equinox	Lowest daily mean temperature				Highest daily mean temperature			
	Midnight to midnight		Noon to noon		Midnight to midnight		Noon to noon	
	°F	Year	°F	Year	°F	Year	°F	Year
1	30.4	1914	30.1	1896	74.8	1948	78.5	1948
2	21.5	1934	21.3	1934	75.6	1948	69.6	1948
3	23.8	1906	24.9	1906	67.0	1929	70.3	1939
4	26.0	1940	26.1	1896	71.8	1939	69.3	1913
5	26.7	1940	29.0	1896	68.7	1939	72.4	1939
6	29.9	1894	25.9	1894	71.8	1921	73.7	1921
7	27.0	1894	28.3	1923	74.1	1921	75.3	1921
8	29.8	1923	33.8	1904	72.1	1907	74.5	1907
9	34.0	1893	33.1	1941	72.5	1945	73.3	1945
10	26.2	1923	22.9	1923	70.8	1945	69.1	1945
11	25.9	1923	31.0	1919	65.6	1945	70.2	1917
12	31.8	1924	30.8	1924	71.2	1917	71.5	1917
13	34.9	1911	34.6	1911	69.5	1903	72.5	1913
14	35.4	1908	33.0	1903	70.7	1913	68.1	1945
15	35.0	1896	34.3	1944	69.3	1910	72.3	1910
16	34.1	1944	31.0	1898	74.5	1942	76.9	1942
17	35.5	1898	37.4	1898	75.0	1942	77.2	1929
18	38.4	1935	38.0	1935	77.5	1929	76.7	1929
19	35.1	1916	34.2	1916	76.7	1929	77.2	1929
20	34.0	1917	34.5	1909	77.6	1922	78.2	1922
21	34.3	1918	33.2	1918	73.9	1922	71.5	1947
22	34.9	1894	36.4	1894	72.2	1947	64.8	1889
23	39.5	1894	32.8	1940	69.6	1948	69.9	1922
24	34.7	1940	33.7	1923	72.4	1945	74.0	1945
25	36.8	1923	39.0	1943	74.8	1941	75.9	1941
26	35.8	1935	37.4	1928	75.1	1941	75.1	1941
27	38.8	1905	39.7	1904	72.6	1941	72.0	1941
28	38.6	1926	37.2	1926	73.5	1896	76.8	1896
29	37.6	1926	36.5	1926	78.4	1896	78.8	1896
30	41.6	1890	37.7	1904	79.8	1896	81.0	1896
31	38.0	1897	42.0	1947	80.9	1941	77.3	1896
Means....	33.1		32.9		73.2		73.7	

investigation of the statistical reliability of the Arithmetic Mean, and this latter in turn is based on the value—or the estimate of the value—of the standard deviation. Besides showing the daily values of the standard deviation of average daily temperature (which have not been previously published for Washington) the object of this paper is to point out the uncertainty in the standard deviation due to this diurnal variation, a fact not previously emphasized by meteorologists and climatologists.

The question may be asked as to what is the cause of the diurnal variation in the standard deviation of temperature. An explanation is offered here though it is not claimed that it is necessarily the correct one.

It is well known that the air is more stable at night time than during the day; or that vertical mixing and convection are more common during the day. In the latitude of Washington cold and warm air masses are continually passing. Now if the central part, the core so to speak, of a cold air mass passes during the middle of the afternoon, the time when vertical convection is greatest, the effect of the cold air mass is to an extent neutralized. If the central part of the cold air mass passes about sunrise, when the air is most likely to be stratified, its effect will be most pronounced. Hence it would seem that the coldest (lowest) 24 hour averages of temperature could be obtained by choosing the middle of the 24-hour period at sunrise. Also the overturning of a warm surface air mass is more likely to occur when vertical convection is great. And apparently if a warm surface air mass is not overturned (displaced by cold air) during the daylight hours of one day, the probability of its occurring during the night immediately following is sufficiently low to produce the observed diurnal variation in the standard deviation of temperature.

It would also appear reasonable to believe that the hours of the maximum and minimum in the diurnal variation of the standard deviation of temperature vary slightly during different times of the year.

Acknowledgment.—I appreciate very much the help and encouragement Dr. Helmut E. Landsberg has given me with this paper.

REFERENCES

For the normal average daily temperature at Washington, D. C., the reader is referred to the *Climatic handbook for Washington, D. C.*, a publication of the U. S. Weather Bureau, Tables 29 and 30, both on page 44. Table 29 was computed by C. F. Marvin, while Table 30 was computed by John L. Baldwin. For an earlier determination of the Normal daily temperature see: *The daily normal temperature and the daily precipitation in the United States*, by Frank H. Bigelow, U. S. Weather Bureau, Bulletin R. 1908.

For discussions about the merits of different methods of computing the average daily temperature see: *Methods in climatology*, by V. Conrad and L. W. Pollak, 2d ed.: 155–164. 1950. Also *Report on*

the temperatures and vapor tensions in the United States, by Frank H. Bigelow, U. S. Weather Bureau, Bulletin S. 1909.

For singularities at Washington see: *Annual march of temperature at Washington, D. C.*, by G. Slocum, Bull. Amer. Meteorol. Soc. **22**: 220. 1941.

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GEOLOGY.—*Brightseat formation, a new name for sediments of Paleocene age in Maryland.*[1] ROBERT R. BENNETT, U. S. Geological Survey, and GLENN GENE COLLINS, Maryland Department of Geology, Mines, and Water Resources. (Communicated by C. Wythe Cooke.)

Sediments of Paleocene age were considered to be absent in the coastal plain of Maryland until Cushman[2] concluded from his study of Foraminifera obtained from cores and cuttings from a deep oil-test well near Salisbury, Md., in the Eastern Shore area of Maryland, that beds of Paleocene age are present in the subsurface at that locality. Later, in connection with a study by Shifflett[3] of the Foraminifera in the sediments chiefly in the Western Shore area of Maryland, Cushman determined from the Foraminifera obtained from drill cuttings from a water well near Upper Marlboro (Prince Georges County), Md., that Paleocene sediments were present there in the subsurface.[4] Shifflett's study showed that, according to the foraminiferal content, Paleocene sediments are present in the subsurface in other parts of the Western and Eastern Shore areas of the Maryland Coastal Plain.

Additional studies made by the writers and others, in connection with the cooperative ground-water investigations in the Coastal Plain of Maryland by the U. S. Geological Survey and the Maryland Department of Geology, Mines, and Water Resources, showed that this same section of sediments occurred at a shallow depth in some places in the western part of the Coastal Plain. This information indicated that this section of sediments might previously have been overlooked on the outcrop and had been mapped with either the overlying Aquia greensand (Eocene) or the underlying Monmouth formation (Upper Cretaceous).

Sections of sediments exposed in the general vicinity of Brightseat (Prince Georges County), Md. (see locations A, B, C, and D in Fig. 1), have a foraminiferal content and lithology similar to the subsurface section considered by Cushman and Shifflet to be of Paleocene age. A collection of megafossils from the exposed section at location A were studied by Dr. Julia Gardner, of the U. S. Geological Survey, who concluded that they probably represent a northern phase of the Paleocene.[5] Lithologic descriptions of the sections in the Brightseat area are as follows:

LOCATION A: 1 MILE WEST-SOUTHWEST OF BRIGHTSEAT AND 0.2 MILE SOUTH OF SHERIFF ROAD

Aquia greensand (Eocene):
Glauconitic sand and clay; contains black pebbles and black phosphatic nodules at the base; contact with underlying bed is abrupt and irregular..... 2 ft. exposed

Brightseat formation (Paleocene):
Dark-gray micaceous sandy clay; contains megafossils; upper 1'6" contains, in part, material from overlying bed
8 ft. exposed

[1] Publication by permission of the Director, U. S. Geological Survey, and the Director of the Maryland Department of Geology, Mines, and Water Resources.

[2] CUSHMAN, JOSEPH A., *Foraminifera from the Hammond well. In* "Cretaceous and Tertiary Subsurface Geology." Maryland Dept. Geology, Mines, and Water Resources Bull. **2**: 226. 1948.

[3] SHIFFLETT, ELAINE, *Eocene stratigraphy and Foraminifera of the Aquia formation*. Maryland Dept. Geology, Mines, and Water Resources Bull. 3. 1948.

[4] SHIFFLETT, *idem*, p. 1.

[5] Letter, May 8, 1951.

LOCATION C: EAST SIDE OF ADDISON ROAD 0.7 MILE SOUTH OF CENTRAL AVENUE

Aquia greensand (Eocene):
Glauconitic clayey sand; weathers buff; large black pebbles (up to 1 inch in diameter) and black phosphatic nodules immediately above basal contact which is abrupt and irregular.....14 ft. exposed
Brightseat formation (Paleocene):
Light-gray micaceous sandy clay; fossiliferous; contains irregularly shaped masses of material from overlying bed.....1 ft. 3 in.
Indurated dark-gray silty clay; fossiliferous 10 in.
Dark-gray silty clay; fossiliferous 4 ft. exposed

LOCATION D: ABOUT 0.05 MILE WEST OF LOCATION C

Aquia greensand (Eocene):
Greenish-buff glauconitic sand; fossiliferous; basal contact is abrupt and irregular; black pebbles and phosphatic nodules occur immediately above contact.....4 ft. exposed
Brightseat formation (Paleocene):
Fine-textured dark-gray micaceous sandy clay; fossiliferous.....4 ft. exposed

The base of the Paleocene was seen only at location B about 1 mile southwest of Brightseat and 0.2 mile southeast of location A. There the contact with the underlying Monmouth formation of Upper Cretaceous age is abrupt but is even. The presence of a few large pebbles and reworked fossils immediately above the contact, and the abrupt contact itself, indicate an unconformable relation between these beds. The pebble zone, irregular contact, and lithologic contrast between the Eocene and Paleocene sediments at locations A, C, and D also indicate an unconformable relation.

The lithologic character of the Paleocene sediments and the underlying Monmouth formation is similar; however, if they are examined closely some differences can be detected. For example, the Monmouth formation contains a large amount of fragmental carbonaceous material, whereas in the Paleocene sediments it is scarce; moreover, the Paleocene sediments are

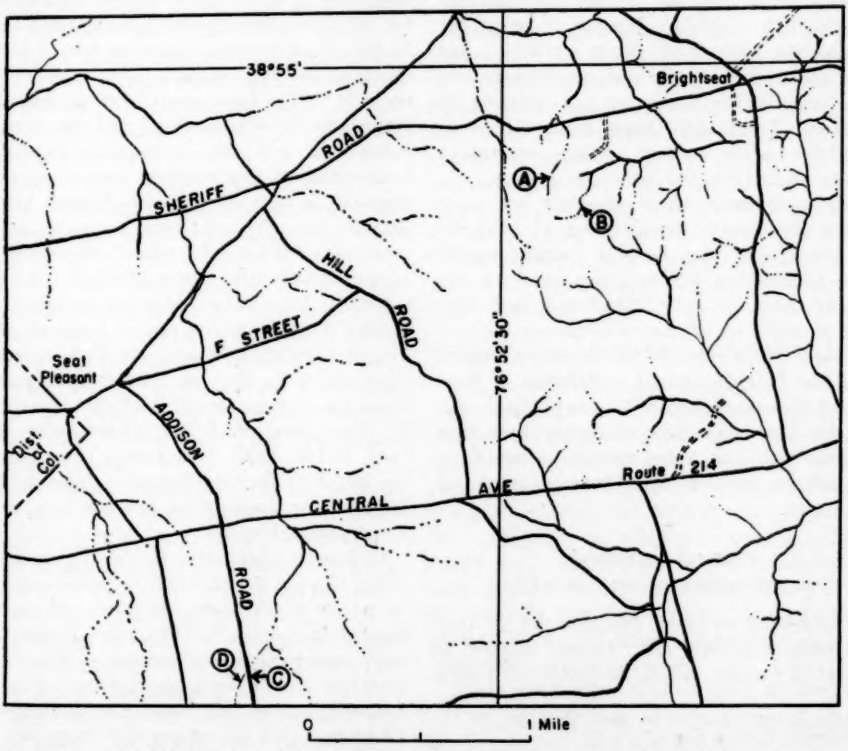


FIG. 1.—Map of Brightseat Area, Md., showing the locations of exposures of the Brightseat formation.

softer and do not have the tendency to break into large pieces or blocks as do the sediments in the Monmouth formation.

The thickness of the Paleocene sediments appears to be extremely variable in the outcrop area. Their thickness at locations A, C, and D probably is about 8 to 10 feet, but at other places along the line of outcrop Paleocene sediments are absent and the Aquia greensand directly overlies the Monmouth formation. For example, Paleocene sediments are absent in the first creek directly west of location A in Fig. 1.

Although the Paleocene sediments do not crop out as a continuous band, examination of drill cuttings and Foraminifera from water wells shows that this unit occurs over a wide area in the subsurface in southern Maryland, where it commonly attains a thickness of 50 to 75 feet.

Inasmuch as this section of Paleocene sediments occurs over a large area, is unconformable with the Eocene and Cretaceous sediments, and constitutes a mappable unit, it seems desirable to give it formational rank. The name Brightseat formation is here proposed for this unit, and the exposure designated by location A in Fig. 1, 1 mile west-southwest of Brightseat, Md., is considered the type locality.

PALEONTOLOGY.—*Nomenclatural notes on carditids and lucinids.* A. CHAVAN, Thoiry (Ain), France. (Communicated by Julia Gardner.)

The revision[1] of several superfamilies, among which Carditacea and Lucinacea are, perhaps, the most puzzling and complex, led the writer to a re-examination of important nome clatural points. Types of common genera, like *Cardita*, *Jagonia*, *Lucina*, or *Diplodonta* (*Taras* of most authors), are still under discussion, and conclusions according with the Rules are not universally accepted. The present paper deals with such problems and reviews, when necessary, points settled in the previous papers.

The conclusions here adopted not only follow the International Rules of Nomenclature in accepting the first unquestionable type-designation for a genus, and in rejecting those wrongly introduced, but they also succeed in saving well-known names, such as *Diplodonta*. It is, therefore, hoped that the International Commission of Zoological Nomenclature will soon place on the Official List the common names here discussed with the type species adopted in accordance with a strict interpretation of the Rules.

CARDITA, CARDITES, ARCINELLA, MYTILICARDIA

Two species are under discussion for the type of *Cardita* Bruguière, 1792 (Encycl. Method. **1:** 401–413): *Cardita sulcata* Bruguière = *Chama antiquata* Linné and *Cardita calyculata* Bruguière = *Chama calyculata* Linné.

In 1799 Lamarck listed *C. calyculata* Linné under *Cardita*; however, according to the Rules, Lamarck's citations of 1799 are not designations, but only examples, as noted by Lamarck himself. In 1801, the same author cited the related species *variegata*, and this, again, is not a type-designation. In 1817, Schumacher distinguished two groups: the "cordiformes" (α) and the "trapeziformes" (β), and cited *sulcata* and *calyculata* as representatives. The first real designation to be discussed is that of Schmidt (Versuch Conch. Samml.: 63. 1818) of *Chama calyculata* as the type of *Cardita* Lamarck, and of *antiquata* as the type of *Cardita* Megerle von Mühlfeld (who used *Cardita* in 1811 without selecting its type). But *Cardita* is of Bruguière, not of Lamarck or of Megerle von Mühlfeld; and as both these species are available for the type, Schmidt's designation of the two of them invalidates both (Stewart, R. B., Proc. Acad. Nat. Sci. Philadelphia, Spec. Publ. 3: 149. 1930). Winckworth (Proc. Malac. Soc. **26** (pt. 1): 23. 1944) has also pointed out that Schmidt's designations are referable only to the authors quoted by him.

Children's designation (Lamarck's *Genera of shells:* 43, pl. 6, fig. 60. 1822) of *Cardita antiquata* = *sulcata* is commonly accepted, and Stewart has recognized it, but Children's designations apply only to Larmarck's genera, so that *Chama antiquata* may be the designated type of *Cardita* Lamarck, but not *ipso facto* of *Cardita* Bruguière. Children makes no reference to Bruguière but

[1] As a contribution to the "Treatise of Invertebrate Paleontology."

refers only to "Hist. Nat. des Animaux sans Vertèbres, 1802–1806," so that his selection is not applicable even to *Lucina* Lamarck of 1799 or of 1801.

The next designation was that by Anton (Verz. Conch.: 10. 1839) of *Cardita calyculata* Gmelin not of Bruguière as the type of *Cardita* "Lamarck, Desh." Gray (Proc. Zool. Soc. London **15:** 193–194. 1847) was the first author to refer to *Cardita* Bruguière; he designated *Chama calyculata* as the type of *Cardita* Bruguière, 1789 (error for 1792), and also of *Cardita* Lamarck, 1801; *Cardita* Schumacher, 1817; and *Chama* sp. Linné.

Cardita Bruguière, 1792 (type by subsequent designation, Gray, 1847): *Chama calyculata* Linné is totally distinct from *Venericardia* Lamarck, while *Cardita* "Lamarck" corresponds partly to *Cardita* Bruguière and partly to *Cardita* Megerle von Mühlfeld, 1811 (type by subsequent designation, Schmidt, 1818): *C. antiquata* Linné, Schmidt's designation for *Cardita* Megerle von Mühlfeld, antedates that of Children for *Cardita* Lamarck, and applies to the same group. Both names are homonyms of *Cardita* and, therefore, synonyms of *Cardites* Link, 1807 (Besch. Rostock Samml.: 153) (type by monotypy): *Chama antiquata* Linné, the first valid name for this group, which is related subgenerically to *Venericardia* Lamarck, 1801.

Arcinella Oken, 1815 (Lehrb. Zool.: 238), type by subsequent designation, Stewart, 1930: *Chama calyculata* Linné is a synonym of *Cardita* Bruguière.

Authors like Schmidt and Gray not only designated a type or example, but also recognized, after Schumacher, that two groups were confused under the name *Cardita* and agreed in regarding the "trapeziformes" as typical and the "cordiformes" as atypical, so that the interpretation here offered is in total accord with the original meaning of *Cardita*.

Chama sulcata Solander, 1766, is a small *Venericardia* "s. l." (after Stewart) and does not invalidate *Cardita sulcata* Bruguière. Therefore *Cardita sulcata* Bruguière is a specific homonym, and this type species of *Cardites* must be named *Venericardia* (*Cardites*) *antiquata* (Lin.) pars = *sulcata* (Brug., non Sol.). *Antiquata* is a somewhat doubtful name, which has been reserved by Poli for the Mediterranean form.

"Mytilicardia" is the Latinization of a vernacular name, "les *Mytilicardes*", published in Blainville (1824) with two examples: *Cardita crassicosta* and *C. calyculata*. Agassiz has cited it without species in the Latin form *"Mytilicardia"* (Nomenclator: 704. 1847). Herrmannsen's designation (Index **2:** 85. 1847) of *Cardita jeson* Adanson (= *senegalensis* Reeve) accords with Blainville's view that *"Perna" jeson* was identical with *C. crassicosta* Lamarck. These species are, in fact, distinct, and "le Jeson" = *Cardita senegalensis* represents a subgenus of *Cardita* Bruguière with the anterior part of tooth 3b obliquely directed backwards: it has been designated the type of *Jesonia* Gray, 1840, by Gray 1847.

The earliest valid Latinization of "les *Mytilicardes*", and prior to that of Agassiz and Herrmannsen, is that of Anton, 1839 (*op. cit.*)[2] under the spelling *"Mytilicardita."* The type is *C. calyculata*, as quoted by Gray, 1847, so that *Mytilicardita* falls in the synonymy of *Cardita* Bruguière.

The usual spelling *"Mytilicardia"* Blainville is used in Tryon, 1872.

All the above cited uses intending to give a Latinization of the same vernacular term, and the first of them, *Mytilicardita*, being a synonym of *Cardita*, *Mytilocardia*, without species, has no status, and *Mytilicardia* falls also in the synonymy of *Cardita*, Herrmannsen's designation referring to a species which proves to be different from the two included in the original list. So that *Jesonia* Gray, n. n., according to Sherborn, is available for the *senegalensis* group, while *Actinobolus* "Klein" Mörch, 1853, of which the type is *C. sulcata* = *antiquata*, is to be listed in the synonymy of *Cardites*.

PSEUDOCARDIA, VETOCARDIA, VETERICARDIA

Pseudocardia Conrad, 1866 (Amer. Journ. Conch. **2:** 103) was a heterogeneous unit, including true carditids, among them *Venericardia dupiniana* d'Orbigny and species of cardiid affinities, such as *Cardium haueri* Hoernes which is a Limnocardiid, and for that reason Fischer, 1887 (Manuel de Conchyliologie, p. 1039), placed *Pseudocardia* pars, in the synonymy of *Limnocardium*. Thirteen unlike species are listed by Conrad under *Pseudocardia;* the first one is cited as *"C. Smidti* HORN.", apparently an error for *Cardium schmidti* Hoernes.

Three years after, Conrad (*ibid.* **4:** 246) re-

[2] The *C. calyculata* of both Anton and Gray seems to include more than one species.

placed *Pseudocardia* by *Vetocardia*, because of the prior use of *Pseudocardium* Gabb, 1866 (not 1869, as indicated in Neave). According to the present Rules, *Pseudocardium* does not invalidate *Pseudocardia*. This substitution of name in Conrad's paper (1868, publ. Feb. 4, 1869) is not accompanied by a citation of species, so that, in February 1869, *Vetocardia-Pseudocardia* was still a doubtful unit, ill-characterized and without type-designation.

But in July, 1869 (*ibid.* **5:** 43) Conrad redefined his genus and cited under it a single species (p. 48), *Vetocardia crenalirata*, which was not included under *Pseudocardia* in 1866. In 1872 Conrad replaced *Vetocardia* because "this genus was improperly printed" by *Vetericardia* (Proc. Acad. Nat. Sci. Philadelphia 1872: 52) and cited two species, *V. crenalirata* and *V. dupiniana*.

Stoliczka, in his discussion of *Palaeocardita* on page 280, writes: "I believe that to this genus should be referred a great number of Cretaceous Carditacea of the type of *C. dupiniana* d'Orbigny." Before the introduction of *Vetericardia*, in 1872, but after the publication of the monotypic *Vetocardia* in 1869, Stoliczka (Cret. Fauna South Ind., *Pal. Ind.* 1871, Lamell, p. 283) discussed the affinities of *Pseudocardia-Vetocardia* and wrote "Conrad called some of the Cretaceous species at first *Pseudocardia* for which name he subsequently substituted *Vetocardia* as the type of which *Venericardia dupiniana* d'Orb. can fairly be taken."

Eames[3], after Cox (Proc. Malac. Soc. London **27**(1): 37. 1946), has recently accepted Stoliczka's statement as a valid designation, but I think it is a very questionable one.

First, such a "designation" is unusual in Stoliczka's work, for he clearly writes: "Type: . . ." when intending to designate a species. "Can fairly be taken," translated into French, appears to be more a suggestion than a selection. Stoliczka's English seems a little ambiguous and when translated into French is even more difficult to understand clearly, for on the same page Stoliczka writes that the genus has no signification, and is probably a synonym of *Palaeocardita*. It is evident that Stoliczka intended only to suggest, rather than to designate, a characteristic species while awaiting a restudy and careful comparisons of a difficult group.

Another very important argument is that Stoliczka overlooked the redefinition of *Vetocardia* and did not realize that its use with a single species not previously cited under *Pseudocardia* necessitated either the recognition of two distinct units, with a type to be selected for *Pseudocardia* and *crenalirata* for *Vetocardia* of July 1869; or, according to Conrad's indication that *Vetocardia* was a substitute, the selection of the species for which this term was used, its redefinition preventing the use of any of the very different forms cited in 1866. But Stoliczka's "designation," being common to two names, of which the former is heterogeneous and the latter, proposed "in replacment," but used for a single species not previously cited, cannot be accepted. No designation has yet been given for *Pseudocardia* or for *Vetocardia* (Eames only accepts Stoliczka's writing), but in 1941 Stephenson (Univ. Texas Publ., Bull. 4101: 175) designated "*Astarte crenalirata* Conrad" as the type of *Vetericardia* Conrad, 1872, and, according to the Rules, this applies *ipso facto* to *Vetocardia* of July 1869, used for the same species and mentioned by Stephenson. So that *Vetericardia* Conrad, 1872 (= *Vetocardia* Conrad, July, non February 1869), can validly be used with *Astarte crenalirata* as its type. It is impossible to design another species and to reject both *Vetericardia* and *Vetocardia* of July 1869 into the synonymy of *Pseudocardia*, since, despite Conrad's indication, they apply to a redefined unit, which was used for a single species, which was not listed either under *Pseudocardia* or *Vetocardia* of February 1869. But as *Pseudocardia* is totally heterogeneous and remains without selected type, for Stoliczka's "designation" applying to both names is valueless. I hereby designate "*Cardium Smidti*" Horn as the type of *Pseudocardia*, the first species listed by Conrad, 1866 (*op. cit.*).

In a recent paper[4], I have proposed the genus *Ludbrookia* Chavan, 1951, type (o.d.): *Venericardia dupiniana* d'Orbigny, because this species is, in fact, quite distinct from the *Vetericardia* stock as well as from *Venericardia*, with which Eames unites it (as a "*Pseudocardia*"). This was, probably, more advisable than to replace Stoliczka's wrong "designation" by a correct one of the same species for *Pseudocardia* only; *dupiniana* having been listed not only under this

[3] EAMES, F. E., *A contribution to the study of the Eocene of western Pakistan*. Philos. Trans. Roy. Soc. London, ser. B, No. 627: 372. 1951.

[4] CHAVAN, A., *Dénominations supraspécifiques de mollusques modifiées ou nouvelles*. C. R. somm. S. G. F., 1951: 210–212.

heterogeneous term, but in 1872 under *Vetericardia* also, together with *crenalirata*, and recently under *Venericardia* by Eames (as "type" by Stoliczka of *Pseudocardia*).

I wish to point out that *Vetocardia* having been used twice by Conrad before its replacement, it seems difficult to follow this author when he says he intended to correct only a misprint.

The type is known as *crenalirata* Conrad, 1860. However, in July 1861, Isaac Lea included it in a checklist under the name *Astarte crenulirata* Conrad.

LUCINA

In a previous paper[5] I have discussed in full the status of *Lucina* Bruguière, 1798, and have accepted *Venus jamaicensis* Spengler as its type, following a number of authors, but disagreeing with Stewart's interpretation (*op. cit.*: 175–178). In a recent paper, Eames (*op. cit.*: 382) does not refer to Stewart but accepts, like him, *Venus pennsylvanica* Chemnitz, a species belonging to the well-known *Linga* de Gregorio, 1885, which, therefore, would fall in the synonymy of *Lucina*. Curiously enough, although adopting the same conclusion, Eames refers to Schmidt's designation (1818) rejected by Stewart, who refers to Anton's paper of 1839, as the first unquestionable designation for *Lucina* Bruguière.

A short historical restudy will find easily what species has been clearly and correctly designated as the type of Bruguière's genus, prior to any other unambiguous designation, and in total accordance with the Rules.

Lucina appears in Bruguière's Encyclopedy (Encycl. Math., Tab. Vers, pl. 284–286) at the top of three plates of shells (and not of only plate 284, as quoted by Eames). According to the Rules, the identification of the species figures by Bruguière being possible—and having been done by Dillwyn, 1817—*Lucina* is "a genus with an indication" and not a *nomen nudum* (as I had myself admitted) so that a valid type-designation must refer to Bruguière, and not to a subsequent worker.

The first generic diagnosis of *Lucina* is by Lamarck (1799), who cites a species (*Venus edentula*) disagreeing with it. But it has been ruled that Lamarck's citations of 1799 are only examples, as stated by himself—this one being inadequate—and not type-designations, so that *edentula* is fortunately not the monotype of a genus defined as having well-developed teeth. These conclusions are now generally accepted, and Eames has recently shown that *Anodontia* Link, 1807, was, as I had admitted, but in disagreement with Stewart's statement, the first valid generic name for "*Lucina*" *edentula* (see Gardner, 1951).

In 1801, Lamarck (Syst. Animaux sans Vert.: 124) gave a better example of *Lucina*, with *L. jamaicensis* as sole citation under this genus. After Lamarck, the meaning of such a citation is as follows: "Pour connaître d'une manière certaine les genres dont je donne ici les caractères, j'ai cité sous chacun d'eux une espèce connue ou très rarement, plusieurs." So that, although not a valid designation, this is a virtual one, giving, at least, Lamarck's choice in the selection of a typical form. Subsequent designations of *L. jamaicensis* by several authors, are therefore in total accordance with the original concept of the genus, while designations of *L. pennsylvanica* are not, this species having been excluded from the "Lucines" by Roissy (1805) and, apparently, by most revisers before the publication of Stewart's paper.

The first real type-designation is by Schumacher (1817), who selected *L. pennsylvanica*, but for *Lucina* Lamarck, without reference to Bruguière's work so that this designation has been rejected as not valid by Stewart and others.

The second one, accepted by Eames, is by Schmidt (1818), also *L. pennsylvanica*. Eames (*op. cit.*) accepted it on reference to Winckworth's opinion that Schmidt has really designated types for several genera, among them *Lucina*. But Winckworth has not discussed this particular designation, which is a questionable one, as pointed out by Stewart (*op. cit.*), who did not accept it. Although referring to Bruguière's genus, Schmidt has quoted plate 284 only (on which are several species figured) and, above all, he designated also *pennsylvanica* as the type of *Lucina* Lamarck, with an inexact reference to Chemnitz's figures of *jamaicensis*. Such a double and confused designation must be rejected, as already done by Stewart, but the pertinent objections were not discussed in Eames' paper; Eames says that Schmidt's designation seems to be "the earliest valid" one, referring only to

[5] CHAVAN, A., *Essai critique de classification Lucines. I.* Journ. Conchyl. **81**: 133–153. 1937.

Winckworth's general opinion on such selections by Schmidt.

The third is by Children (1823), and I had accepted it in my first paper (*op. cit.*). But Children referred only to Lamarck's *Lucina*, and his designation of *L. jamaicensis*, like that of *pennsylvanica* by Schumacher, deals only with *Lucina* Lamarck. Recent additions to the Rules do not permit the consideration of *Lucina* Bruguière as a *nomen nudum*, apart from its interpretation by Lamarck (which was possible when I wrote my first paper).

Anton's designation of *L. pennsylvanica* (1839) has been accepted by Stewart as the first valid one. It is the only one *Lucina* printed by Anton in small capitals. But, although indicating in his introduction that such a printing was reserved to generic typifications, Anton commonly used it also for subgenera. In the case of *Lucina*, four "groups" are recognized, instead of subgenera, the first species of each being printed in italics. This printing typifies them, as pointed out by Eames (*op. cit.*). *L. pennsylvanica* being also printed in italics ahead of the third group (c), is thus on the same rank that three other species, despite the fact it was also printed in small capitals when listed among the heterogeneous species of group c. One can hardly know what printing must prevail, since the "type designation" is here subordinated to a "group" subdivision and typification.

Herrmannsen's designation (1847) of *L. pennsylvanica* is for *Lucina* Bruguière and *Lucina* Schumacher. But the same year, Gray has given the first valid designation I have been able to find, of *L. jamaicensis* as the type of *Lucina* Bruguière, while *Lucina* Schumacher is clearly separated as a synonym, having another type (*pennsylvanica*). This selection is not only the first unquestionable one, but it is in accordance with Lamarck's first implicit selection (1801), quoted above and confirmed by Children's designation for *Lucina* Lamarck, 1801, which therefore is a synonym of Bruguière's genus.

Gray's selection has been followed by subsequent best authors, like Stoliczka (1871) and Meek (1876) and has been disregarded only when opinions favoring the retention of "*Venus edentula*" by "monotypy" have been expressed. This "monotypy" referring to Lamarck's work of 1799, now rejected for type-designations, and both Schmidt's and Anton's choices proving to be questionable, *Lucina jamaicensis* must be accepted as the type of *Lucina* Bruguière, as designated by Gray, 1847.

It is interesting to point out that the former Rules—now rejected but followed during many years by well-known specialists—would have led to the same conclusion, if the type had to be chosen "by elimination"; *L. edentula* being then rejected for inappropriateness, and *L. pennsylvanica* as excluded from the "Lucines" by Roissy, *L. jamaicensis*, first and single species cited in 1801, would have been yet the only one to be validly available.

As in any manner, and in total accordance with the present Rules, *L. jamaicensis* is the type of *Lucina* Bruguière—unless we accept arbitrarily another designation among the prior ones, which prove all to be strongly questionable, it is here proposed that *Lucina*, with *jamaicensis* as its type, shall be soon placed in the "Official List of Generic Names", this having the advantage of definitely saving the well-known *Linga*, which is available for the *pennsylvanica* group, and of rejecting in synonymy the vernacular *Phacoïdes*, generally used for designation of any lucinid that can not receive an exact generic assignment.

PHACOÏDES

As often pointed out, *Phacoïdes* "Blainville, 1825" (Dict. Sci. Nat. **32:** 334) is only a vernacular name[6]: "Les Lucines Phacoïdes" having no status. *L. jamaicensis* is cited under it as an example.

The word *Phacoïdes* is found first in Agassiz (Nom. Zool. Moll. **2:** 67) in 1845 as a name without species, being merely a quotation from Blainville. Its second use is by Gray, 1847 (Proc. Zool. Soc. London: 195) in the synonymy of Lucina, of which *L. jamaicensis* is designated as the type. Its third use is by H. and A. Adams, 1858 (Gen. Rec. Moll. **1:** 467), also as a synonym of *Lucina* Bruguière, of which *L. jamaicensis* is given as an example.

Eames (*op. cit.*), having selected *L. pennsylvanica* as the type of *Lucina*, thinks that *Phacoïdes* (Blainville) H. and A. Adams can be accepted as "the first valid use of this name" with *L. jamaicensis* as monotype. But it is not the first valid use at all: despite the fact that Agassiz first used *Phacoïdes* as a genus without species, Gray, prior to H. and A. Adams, used it also as a synonym of *Lucina*, and with a type-designa-

[6] See Iredale (1915), Stewart (1930), Eames (1951).

tion for the latter not only an example. I cannot understand how the citation of *jamaicensis* as example only for *Lucina* can be applied as a monotype for *Phacoïdes:* such a selection after Adams cannot be accepted.

But as Gray himself has only quoted *Phacoïdes* in synonymy of a nonmonotypical genus, his type-designation for *Lucina* is not, *ipso facto*, available for *Phacoïdes* as monotype. *Phacoïdes* itself cannot be monotypical, Blainville having written "Les Lucines Phacoïdes."

Agassiz, Gray, and Adams have all only quoted the word "Phacoïdes" after Blainville in their papers, without species referred to this name; it is not even certain that they have used it as = Latinized. One cannot affirm that they intended to quote a Latin genus *Phacoïdes*, instead of only a French word, transferred from an adjective to a substantive: (Les) Phacoides. So that "*Phacoïdes*" must be rejected as vernacular in any manner, no Latin use of it prior to *Dentilucina* Fischer, 1887, being demonstrated by its connection to a specific Latin name. Neither Gray nor Adams have referred to "*Phacoïdes jamaicensis*" but only listed a vernacular name in a synonymy; and on page 194 of his paper, Gray similarly quoted as a synonym of a Latin generic name (*Agaria*) the "Cardito-Cardite" of Blainville under its vernacular form, not *Cardiocardita*.

If a valid and unquestionable designation of *L. pennsylvanica*, or of any species other than *L. jamaicensis* is found as the type of *Lucina* Bruguière prior to Gray's selection, *Dentilucina* would then replace *Lucina* for the *jamaicensis* group, and not *Phacoïdes*, as several authors have already noted.

Before studying other names, it is interesting to point out that a case almost similar to that of *Cardita* and *Lucina* has been ruled recently by the International Commission in the same sense. *Arca Noae* Linné has been officially established as the type of *Arca* Linné, 1758, following Gray's selection, instead of Schmidt's or Schumacher's prior, but questionable, designations. But in the case of *Arca*, a suspension of the Rules was necessary, because Schumacher's designation was only somewhat questionable, according to Reinhart (1935) but not to most authors. In the case of *Cardita* and of *Lucina* such a suspension would not be needed, all designations prior to Gray's being evidently erroneous in their references, and not concerning Bruguière's work.

DIPLODONTA AND TARAS

Diplodonta Bronn, 1831 (Ergebn. Nat. Reisen **2:** 484), is a well-known ungulinid, with *Venus lupinus* Brocchi (non Linné) = *Tellina rotundata* Montagu var. *aequilateralis* Cerulli (*Diplodonta*) as its type, designated by Herrmannsen and by Gray, both in 1847. There is a prior *Mysia* Leach in Brown, 1827, with the same species as monotype, but invalidated by *Mysia* Lamarck, 1818.

There is also *Taras* Risso, 1826, type (monotype) *T. antiquatus* Risso (Hist. Nat. Eur. Mérid. **4:** 344) from the Pliocene beds of La Trinité, near Nice. Stewart (*op. cit.*) thinks that this species is identical with the Recent *Diplodonta rotundata* (Mtg.) and therefore that *Taras* must have priority over *Diplodonta*.

Taras antiquatus, only figured by Risso, looks, in fact, like *Diplodonta rotundata*. Dall had interpreted the diagnosis of its hinge as that of a specimen of this species on which the left posterior cardinal was broken off, and the right posterior confused with a lateral tooth. But Cerulli (1909) and Lamy (1920) treated *Taras* as a doubtful name, and Eames (1951) also has recently listed it as a *nomen dubium*.

Stewart was of the opinion that "it should not be difficult to identify *T. antiquatus* at Trinité." However, in this locality as well as on the Mediterranean coast, another quite different species can be found which is externally and internally very similar to *Diplodonta rotundata*. Modern authors seem not to have realized that *Taras antiquatus* was, perhaps, a specimen of *Mysia undata* (Pennant), also known as *Lucinopsis undata*.

It is a venerid, with a deep pallial sinus, and a third narrow, cardinal tooth, just in front of the nymph (perhaps the "right posterior" discussed by Dall): however, both the shape and hinge of *Mysia undata* recall strongly *Diplodonta rotundata*, especially when the specimens are worn. Both species are not uncommon in the recent fauna.

As I have failed to find specimens labelled *Taras antiquatus* in the Risso material preserved in the Paris Museum, I am of the opinion that the name must be rejected as a *nomen dubium*, since it may be that Risso has described a *Mysia*, as well as a *Diplodonta*, and since no type material can be studied.

I have noticed, when examining Risso's shells, that their original labels have, sometimes, been

misplaced and several specimens apparently misidentified. If some day shells labelled "*Taras antiquatus*" should be discovered (and probably not, then, in the Paris Museum where I have failed to find them and where they have not been listed), it would be yet necessary to verify with much care if they are really the true *Taras* Risso has studied. So that there is only a very slight possibility that *Taras* can have status of any kind, and *Diplodonta*, therefore, can be confidently used.

I have failed to find, among numerous carditid and lucinid units, other unsettled generic terms of the importance of those here discussed; so that I think it was of interest to study them in full, as I have tried to do it in the present paper. It is very satisfactory to see that a strict application of the International Rules has succeeded in saving well-known names. Wise decisions of the Commission having already placed several usual genera in the Official List, I hope that *Cardita*, *Lucina*, and *Diplodonta*, at least, may obtain the same favor.

BOTANY.—*New species of grasses from Venezuela.* AGNES CHASE, Department of Botany, U. S. National Museum.

The genus *Thrasya* H.B.K., Nov. Gen. et Sp. **1**: 120. *pl. 39.* 1816, was based on a single species, *T. paspaloides* H.B.K., collected by Humboldt and Bonpland on the island of Panamuna, in the Orinoco between Atures and San Borja, Venezuela. There are now 12 known species of *Thrasya*, ranging from Costa Rica to Brazil and Bolivia, four of them from Venezuela, to which a fifth is now proposed. In this genus the sterile lemma is mostly firm, thinner and sulcate down the middle and usually splitting to the base, the margins of the split rolling inward. In the species here described the sterile lemma partly splits tardily or not at all, as in *T. campylostachya* (Hack.) Chase and *T. hitchcockii* Chase, and the plant somewhat resembles *Paspalum pilosum* Lam.

Thrasya venezuelana Chase
Fig. 1

Planta perennis; culmi 50 cm alti, erecti, dense hispidi, nodis inferioribus ramosi; vaginae et laminae appresso-hispidae; ligula minuta; laminae 15–20 cm longae, 6–8 mm latae; racemi 1–3, arcuati, 8–13 cm longi, rhachi 2 mm lata, marginibus longe hispidis; spiculae crebrae, 4 mm longae, 2 mm latae, dense hispidae; gluma prima obsoleta; gluma secunda et lemma sterile subaequalia, 3-nervia, lemmate sterili sulcato non vel tarde fisso; fructus 3.5 mm longus, 1.5 mm latus, marginibus lemmatos et paleae appresso-pubescentibus.

Perennial, in small tufts; culms 50 cm tall, erect, appressed-hispid, branching from the lower nodes, the lower internodes 4–5 cm long, the nodes densely hispid; branches erect, the prophylla prominent, thin, to 5–6 cm long; foliage conspicuously appressed-hispid; sheaths exceeding the internodes; ligule a brown membrane 0.5 mm long; blades rather thick, 15–20 cm long, 6–8 mm wide, about as wide at the base as the summit of the sheath, folded and flexuous in age; racemes on slender erect peduncles, 1–3 from the upper sheaths, the racemes strongly arcuate, 8–13 cm long, the rachis narrowly winged, 2 mm wide, appressed-pubescent, the margins long-hispid; spikelets crowded, 4 mm long, 2 mm wide, rather turgid; first glume obsolete; second glume and sterile lemma 3-nerved, densely hispid with pale hairs, the glume slightly shorter than the lemma, the lemma sulcate, not or tardily partly splitting, its palea of equal length, with firm minutely pubescent margins, enclosing 3 rudimentary stamens; fruit 3.5 mm long, 1.5 mm wide, subacute; lemma and palea minutely papillose-striate, the margins of both sparsely appressed-pubescent.

Type in the U. S. National Herbarium, no. 1762139, collected on dry stony open slope, among low brush, Sabanas de Cotiza, Distrito Federal, Venezuela, March 11, 1940, by Agnes Chase, no. 12407. Part of the type is in the herbarium of the Instituto de Botánica, Caracas, Venezuela.

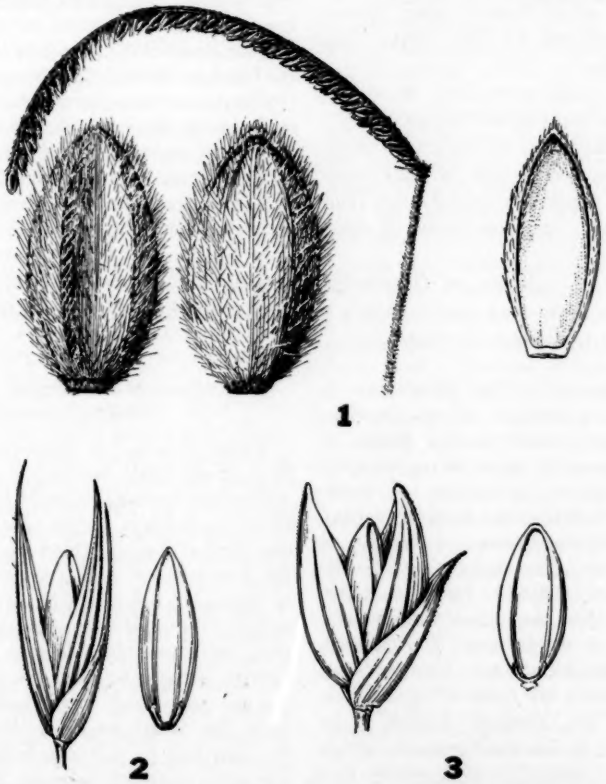
Ichnanthus tamayonis Chase
Fig. 2

Planta annua; culmi ramosi decumbentes, 65–90 cm longi, gracillimi, angulati, pilosi, internodiis inferioribus brevibus, nodis tumidis, saepe radicosis, superioribus ad 15 cm longis; vaginae

pilosae, marginibus ciliatis; ligula 0.3 mm longa; laminae anguste lanceolatae, 5–10 cm longae, 4–7 mm latae, acuminatae, basi rotundatae, tenues, laxae, subtus molliter pubescentes, supra scaberulae; paniculae terminales et axillares, 6–8 cm longae, 3–4 cm latae, laxae, ramis ascendentibus, 1–5 cm longis, ramulis 1–3 spiculas ferentibus; spiculae 4.2–4.4 mm longae, glumis et lemmate sterili acuminatis; fructus 2.6 mm longus, basi appendicibus nullis.

Annual; culms decumbent, 65–90 cm long, very slender, angled, pilose, the lower internodes short, the nodes swollen, few to several of them with slender prop-roots 4–10 cm long; sheaths, except the uppermost, 1–2 cm long, the uppermost 3–4 cm long, pilose (the uppermost sparsely), the margins densely ciliate; ligule membranaceous, 0.3 mm long; blades narrowly lanceolate, 5–10 cm long, 4–7 mm wide, long-acuminate, rounded at base, thin, lax, softly pubescent on the lower surface, the upper surface subglabrous, the fine nerves scaberulous; panicles terminal and axillary on long very slender angled peduncles, pilose below the panicles; terminal panicles lax, 6–8 cm long, 3–4 cm wide (the axillary mostly smaller), the very slender angled axis sparsely pilose, the branches ascending, 1–5 cm long, with short ascending branchlets bearing 1–3 short-pedicellate spikelets, at least the lower axils pilose; spikelets 4.2–4.4 mm long; first glume long-acuminate, a little shorter than the sterile lemma, 3-nerved, the midnerve scabrous; second glume acuminate, 4.2–4.4 mm long, 5-nerved, the nerves scabrous, sometimes with a few hairs on the midnerve; sterile lemma 4–4.1 mm long, 5-nerved, the nerves scabrous; fruit 2.7 mm long, the basal wings reduced to scars.

Type in the U. S. National Herbarium, no. 1858484, collected in "sitios abrigados, Dist. Fed.:



FIGS. 1–3.—*Thrasya venezuelana*, n. sp.: 1, Raceme, ×1, two views of spikelet, and fruit, × 10, type; 2, *Ichnanthus tamayonis*, n. sp.: Spikelet and fruit, × 10, type; 3, *Ichnanthus nubilus*, n. sp.: spikelet and fruit, × 10, type.

Carretera Catia - El Junquito," Venezuela, October 8, 1943, by Francisco Tamayo, no. 2564.

A duplicate of the type is in the herbarium of the Instituto de Botánica, Caracas, Venezuela.

Ichnanthus nubilis Chase
Fig. 3

Planta annua; culmi ramosi decumbentes, 60–100 cm longi, graciles, angulati, infra nodos papillosis-pilosi; nodi pilosi; vaginae papillosae-pilosae; internodii 1.2–2.5 cm longi, papillosi-pilosi, ciliati; ligula brevissima; laminae anguste lanceolatae, 5–10 cm. longae, 4–8 mm latae, acuminatae, basi constrictae, tenues, infra obscure reticulatae; paniculae terminales et axillares, pedunculis gracillimis longissimis; paniculis 2.5–3.5 cm longis, 5–10 mm latis, 2–6 spiculas ferentibus; spiculae 3.5 mm longae, glumis et lemmate sterili firmis; gluma prima acuminata 2/3–3/4 spiculae aequans, 5-nervis; gluma secunda 3.5 mm longa, subacuta, 5-nervis; lemma sterile 5-nerve, quam gluma secunda brevius; fructus 2.5 mm longus, basi appendicibus nullis.

Plants annual; culms decumbent, 60 to 100 cm long, slender, strongly nerved to angled, papillose-pilose below the nodes and sometimes along one of the nerves; nodes pilose; sheaths much shorter than the internodes (mostly less than 2.5 cm long), finely papillose-pilose, at least toward the summit and on the collar, finely ciliate; ligule minute; blades narrowly lanceolate, 5–10 cm long, 4–8 mm wide, acuminate, narrowed at base, thin, faintly reticulate on the lower surface, and sparsely pilose to glabrous on both surfaces; panicles terminal and axillary on long very slender angled peduncles, the panicles 2.5–3.5 cm long, 5–10 mm wide, the short ascending scabrous branches bearing 2–6 short-pedicelled spikelets; spikelets 3.5 mm long, the glumes and sterile lemma firm; first glume abruptly acuminate, 2/3–3/4 as long as the spikelet, 5-nerved, the midnerve scaberulous toward the apex; second glume 3.5 mm long, subacute, 5-nerved; sterile lemma similar to the second glume, slightly shorter, 5-nerved; fruit 2.5 mm long, the basal wings reduced to scars.

Type in the U. S. National Herbarium, no. 1762167, collected near the upper margin of cloud forest, El Junquito, Cordillera Costanera, Distrito Federal, Venezuela, March 12, 1940, by Agnes Chase, no. 12439.

A duplicate of the type is in the herbarium of the Instituto de Botánica, Caracas, Venezuela.

Ichnanthus tamayonis and *I. nubilis*, creeping, shade-loving species, resemble *I. angustifolius* Swallen of the Eastern Cordillera of Colombia, but are freely branching and bear axillary as well as terminal panicles with spikelets glabrous or with scabrous nerves only.

ENTOMOLOGY.—*Notes on Bruchidae affecting the Anacardiaceae, including the description of a new genus.* JOHN COLBURN BRIDWELL, Lignum, Va. (Communicated by Waldo L. Schmitt.)

Anyone interested in the Bruchidae is intrigued by the relatively few species that diverge from the usual family habit of feeding their young in seeds of legumes by attaching themselves to plants of other families. We have three records of Bruchidae affecting the Anacardiaceae, a family of plants represented in temperate North America almost entirely by the polymorphic genus *Rhus*, including the sumacs, poison ivy, and smokebush. The genera affected by Bruchidae are Chilean and Brazilian, and both are close allies of *Rhus*. These genera are *Duvaua* Kunth, now usually included in *Schinus* Linnaeus, which includes the "California" peppertree, and *Lithraea* Miers, which includes the Chilean litre, *L. caustica* (Molina) Hooker & Arnott (*venenosa* Miers).

1. GALL-MAKING BRUCHID OF *Schinus huigan* (CHILE)

Kieffer and Herbst (Zeitschr. Wiss. Insekt.-Biol. **1**: 66. 1905) reported a bud gall in the axils of the flowering twigs of *Duvaua dependens* DC (= *Schinus huigan* Molina), which is described as follows: These are easily dislodged, being attached at only a single point. The gall is ellipsoidal, 6–8 mm high by 5–6 mm broad, naked, red flecked with white, the middle of the flecks sometimes tuberculately prominent. The texture of the gall is somewhat woody. Within the gall lies a thick curved footless beetle larva with the body gradually thickened behind, 8–9 mm long by 2–3 mm broad, naked except for some scattered hairs on the anterior segments, mandibles dark.

This material was obtained by Pablo Herbst between Santiago and Valparaiso on November

3, and later a new species of *Bruchus* was reared from these larvae.

Since this still undescribed species is one of the few Bruchidae affecting plants in parts other than seeds, it would be a useful work for some of our Chilean friends to recover this species and have it described.

2. *Lithraeus electus* FROM THE SEEDS OF LITRE (CHILE)

Prof. Carlos Porter (Revista Chilena Hist. Nat. **29:** 286. 1925) reported determining the attractive *Bruchus elegans* Blanchard in material submitted to him for identification by Prof. Flaminio Ruiz, obtained by the latter from the seeds of litre, *Lithraea caustica*, from Sauzal (Province of O'Higgins) in January 1924. Since Camacho (*Algunos insectos perjudiciales á las arvejas, frijoles, lentejas y otras legumbres y brucos del trebol*, Serv. Policia Sanit. Vej., Santiago de Chile, 1919: 22–23) had previously erroneously reported this species affecting seeds of clover, I sought confirmation for Professor Porter's record. With this in mind I examined several lots of seeds of litre in the collection of the Office of Foreign Plant Introduction, U. S. Department of Agriculture. In one of these lots (S.P.I. No. 27434) were found four seeds showing insect injury. Three exhibited exit holes, evidently of some hymenopterous insect smaller than *Bruchus elegans*. This should be a parasite of a bruchid, but it might also be some seed inhabiting chalcid. Fortunately, the fourth seed still contained an insect. When this was extracted from within its slight silken cocoon, there was found a nearly mature braconid identified by C. F. W. Muesebeck as a species of *Urosigalphus*. Since some of the species of *Urosigalphus* parasitize bruchids, and others attack curculionids, the remains of the beetle larva at the expense of which the *Urosigalphus* larva had nourished itself were extracted and submitted to Dr. Adam Böving. The fragments were sufficient to enable him to determine them positively as those of a bruchid larva. We may hope that ultimately the larvae of Bruchidae will be identifiable, since Dr. Böving has admirably worked out the mouth parts (Proc. Ent. Soc. Washington **29:** 133–143. 1927). However, the larva of *Bruchus elegans* is still undescribed, and so no matter how perfect the larva might be it would still be impossible to determine it to species. We were not, therefore, quite able to confirm fully Professor Porter's record as to the species concerned. But a bruchid certainly does affect the seeds of *Lithraea caustica* in Chile, and I have no doubt that he is right in his determination, for *Bruchus elegans* is a common, well-known, and strongly characterized species not likely to be mistaken.[1]

Unfortunately, the appropriate specific name *elegans* Blanchard, 1851, is preoccupied by *Bruchus elegans* Sturm, 1845, a valid binomial, and must be replaced. Furthermore, the varietal name *obscurior* Pic, 1902, is also preoccupied[2] and cannot take its place. The species is, I believe, distinct enough to represent a separate genus, and *Lithraeus* is proposed with *Bruchus elegans* Blanchard, 1851, as genotype. For the untenable specific name *elegans* the substitute *electus* is proposed, so that this beautiful seed weevil of the litre may be known hereafter as *Lithraeus electus*.

Lithraeus, n. gen. (Bruchinae, Acanthoscelidini)

Genotype: **Lithraeus electus,** n. name

Bruchus elegans Blanchard, 1851, not Sturm 1843.
Bruchus elegans obscurior Pic, 1902, not *Bruchus (Pseudoptinus) martini obscurior* Pic, 1896.

Freshly emerged individuals of this elegant Chilean bruchid may best be recognized by the pubescent markings, which later are often badly rubbed. With fine sericeous pubescence on head, body and legs above and below, invisible except when seen obliquely; sharply defined decorations of dense snowy white pubescence concealing the surface thus: a small quadrangle on median lobe of pronotum; on the small quadrate scutellum (emarginately bidentate at apex), narrow arcuate elytral fasciae extending obliquely forward from near the middle of fourth stria to near basal third of ninth, an elliptical fleck at the apex of the fourth and fifth striae, on mesepimeron, on narrow outer margin of metapleura, on outer end of hind coxa and small maculae on extreme margin of sternites 2–4, narrow basal margin of pygidium; less condensed and less definite pubescent markings on posterolateral lobes or angles of pronotum and on its flank near front coxa.

Small, 2.3–3.1 mm long by 1.3–1.6 mm broad, ovate, shining black or reddish testaceus, with almost all parts rufescent in some individuals;

[1] Since this part of this paper was prepared, repeated positive proof of this host relationship has been obtained. I do not have any confirmation of Dr. Porter's subsequent record (Revista Chilena Hist. Nat. **43:** 139–140. 1940) of its affecting *Schinus molle* L., the so-called "California" peppertree.

[2] *Bruchus (Pseudoptinus) martini obscurior* Pic, 1896, now referred to *Ptinus*.

head, prothorax, and body beneath generally black; antennae sometimes entirely black, sometimes with some basal joints reddish. Integument everywhere micropunctulate, with coarser punctures on head, pronotum, and hind coxa. Head short, malar space short, temples abruptly declivous; eyes normally convex and projecting, broadly emarginate for two-thirds their length, separated on front by nearly the width of an eye.

Front punctured throughout, without a carina, glabrous impunctate line, or area; antennae alike in the sexes, extending beyond base of pronotum but not to hind coxa, with four narrow joints at base, joint 5 triangularly expanded at apex, 6–10 nearly alike, subquadrate, closely applied to each other, not at all serrate, 11 broadly ovate. Pronotum narrower than elytra and less than half as long; sides nearly straight, converging and suddenly rounded in front; dorsum nearly even, convex, separated from flanks by a vestigial lateral carina bent down to the coxa. Elytra with even surface, flat intervals, epipleural lobes well developed, humeri small, no basal tubercles, striae except 8 and 9 reaching base, 4 and 5 abbreviate and joined at apex, striae perceptibly punctured, well impressed; elytra broadest near basal third, narrowed to apex, covering base of pygidium, not microserrulate at suture. Hind coxa broader than hind femur and broader than first sternite behind it, finely punctured except for the polished area along more than half the anterior margin; hind femur more than three times as long as broad, not extending to apex of abdomen, arcuate above, nearly straight beneath, sinuate before the small apical lamella; slightly flattened apically, inner margin with vestigial carina usually bearing a slightly angulate denticle; hind tibia straight, slightly broader toward apex, entirely without longitudinal carinae, apex abruptly truncate, mucro short and but little different from the lateral tooth which is near it, separated by a shallow sinus; subdorsal denticles smaller, two or three in number.

Numerous American Bruchidae such as *Bruchus* (*Pachymerus*) *albotectus* Sharp, *Bruchus* (*Pachymerus*) *incrustatus* Gyllenhal, and *Pseudopachymerus multimaculatus* and *binotatus* Pic, which have been referred to *Pseudopachymerus* or *Caryedes*, from which they are generically distinct, have the elytra with dense white pubescence over most of the surface but in *Lithraeus electus* most of the elytron is covered with practically invisible pubescence and the white covers only a minor part of the surface. These species with longitudinally carinate hind tibiae and femur armed with tooth and denticles near apex beneath are widely separated from *Lithraeus* by the structure of the hind legs. Most genera of Acanthoscelidini have longitudinal carinae on the hind tibiae: (1) One on outer face ending in a tooth at apex. (2) One on ventral margin ending in the mucro at apex; (3) One on the surface between outer and ventral carinae, often converging apically toward the ventral carina; (4) One on the inner face, not related to any apical structure. The complete absence of such carinae in *Lithraeus* distinguishes it from any other American bruchid genus known to me.

3. A BRUCHID FROM THE SEEDS OF AROEIRA (BRAZIL)

Gregorio Bondar, 1937, records a third bruchid affecting a plant of the family Anacardiaceae in Brazil (Rio) in his *Notas biologicas sobre bruchideos observados no Brasil* (Arch. Inst. Biol. Vegetal **3:** 7–44, figs. 1–61 [December, 1936]), a work largely reprinted from previously published papers in Correio Agricola (Bahia), O Campo (Rio de Janeiro), Revista de Entomologia (Rio de Janeiro), and perhaps elsewhere, 1930–1932, the details of which I cannot here quote. This paper by Bondar is the most significant single contribution to the biology of Bruchidae known to me. Bondar's too brief note (p. 43) reads thus: "*Bruchus atronotatus* Pic. Cria-se en sementes de aroeira. Rio."

The bruchid species was described by Pic 1929, Mélanges **54:** 35, Brésil (type in coll. Pic). It was listed by Blackwelder, *Checklist of the coleopterous insects of Mexico, Central America, the West Indies, and South America*, U. S. Nat. Mus. Bull. 185 (pt. 4): 758. 1946, as *Acanthoscelides atronotatus* Pic. I do not have the description before me, but I doubt if it would be of service in determining the species if it is in any way like *Lithraeus electus* or particularly related to it.

From Dr. Da Costa Lima's very useful "Indice das Plantas" in his *Terceiro catalogo dos insectos que vivem nas plantas do Brasil*, Rio de Janeiro, 1936, p. 426, we find the vernacular name *aroeira* with or without an adjective, *brava*, *mansa*, or *preta*, applies to *Lithraea brasiliensis*. *Aroeira vermelha* or *manza* is *Schinus terebinthifolius*. My impression is that Bondar meant *Lithraea brasiliensis* as the host of *Bruchus atronotatus*.

ENTOMOLOGY.—*Descriptions and notes on two rare species of Aphididae.* F. C. HOTTES. (Communicated by Herbert Friedmann.)

Opportunity is taken to describe some forms heretofore unknown of two rare species of Aphididae, and to record some notes on their life habits.

Rhopalosiphum grabhami Cockerell

This species was described by T. D. A. Cockerell in 1903. Since that time I am aware of its mention in aphid literature only once, by Gillette and Palmer in 1932. In the fall of 1951 it was present in numbers in pseudogalls made by rolling both halves of the leaf blade toward the midrib. On *Lonicera involucrata* the galls thus formed were red, mottled with yellow. The edges of the leaves were tightly rolled into tubes just large enough for the bodies of the aphids. In such tubes numerous aphids apparently adult, but with undeveloped wings were taken dead, killed by a fungus. Toward the midrib the leaves were more loosely rolled, and it was in these regions that living alate viviparous females and males were taken. Oviparous females were not taken. The male has not been described before.

ALATE MALE

Size and general color.—In life very much shriveled and shrunken; general color black. Mounted specimens, relaxed and cleared, are about 1.45 mm long from vertex to tip of anal plate; width across eyes, 57-mm. Mounted specimens show the head and thorax blackish brown, abdomen with dusky spots at the sides, and smaller spots, irregular in shape and size, arranged in transverse rows across the dorsum. The median spots are larger and more or less confluent, near the posterior; cauda and anal plate dusky; cornicles dark dusky; antennae uniform black; tibiae dark brown with apical portions darker.

Head and appendages.—Comparative lengths of antennal segments as follows: III, .57 mm; IV, .37 mm; V, .31 mm; VI, .11 + .52 mm. Antennal hair slightly knobbed, that on III not so long as width of segment. Secondary sensoria round, tuberculate, arranged as follows: III, 56–60 evenly distributed over surface; IV, 33 evenly distributed; V, 5–11 more or less in a row. All antennal segments imbricated. Primary sensoria on V and VI with a hair rim. Anterior margin of head with a strongly developed median tubercle. Antennal tubercles extremely well developed. Rostrum very short, extending only about midway to mesothoracic coxae, segment before apex very bulbous.

Thorax.—Veins of forewings dark dusky brown; second branch of media about midway between first and margin of wing; radial sector much bowed; hind tibiae 1.07 mm long; hair on inner surface of hind tibiae more abundant than that on outer surface; hair on both surfaces equal in texture and about equal in length. The hair on the proximal surface of the tibiae is shortest, length of hair in midregion less than width of tibiae; apex of tibiae somewhat enlarged. Tarsi .08 mm long. First segment of tarsus deeply recessed within tibiae, this is also true of alate viviparous females. First segment of tarsus apparently with only two hairs.

Abdomen.—Cornicles .20 mm long, with surface imbricated, sides almost uniformally swollen, slightly constricted just before well-developed rim. Cauda, .057 mm long, with three hairs on a side. Anal plate with few long hairs. Gonapophyses short with numerous hair.

Allotype alate male.—Collected September 7, 1951, Skyway, Colo. (Cottonwood Lake Trail) deposited in United States National Museum.

I am not sure that this species is correctly placed in the genus *Rhopalosiphum*. It has much in common with the Myzini.

Lachnus montanus (Wilson)

This species was described by Wilson in 1919 from three "apterous viviparous" females collected by Gillette at Cimmaron, Colo. in 1906. I am not aware of other specimens having been recorded in aphid literature since that time. Dr. Knowlton, however, has sent me an unidentified slide of this species to determine, collected by B. A. Hows at Vallecitos New Mexico in 1943. The host is not recorded; the specimens are apterous.

This species is of especial interest because two kinds of apterous viviparous females occur; females with no sensoria on the hind tibiae and females with sensoria on the hind tibiae. It was from females of the latter type that Wilson described the species. At the time he stated that it was possible for the females to be oviparous, a possibility he promptly rejected because the

specimens were collected in August which he thought too early to produce oviparous females. Despite the presence of sensoria on the hind tibiae, a characteristic as a rule of oviparous females, but not confined to them, such females are viviparous. I can not state that they are always thus, but my material so indicates. They seem to occur in the fall as a generation just preceding the oviparous generation. Because they differ in other respects in addition to the presence of sensoria on the hind tibiae they must be regarded as distinct forms. I have been informed by Professor Palmer, that Professor Essig has a paper in press in which he calls similar forms produced in another genus "intermediates" and I make use of his term. It was my intention to call them pseudo-oviparous.

I took all my specimens in a small region south of Glade Park, Colo. (Piñon Mesa), on scrub oak (*Quercus gunnisonii*). On the larger trees of this species they apparently live singly, of in the case of immature specimens in groups of two or three. I have taken them on the twigs, branches, and trunk. On twigs they seem to show a preference for regions near twig galls, and in one case I collected a female with the head and a portion of the thorax in the cavity of a gall, too small to admit the entire body. On branches and on the trunk, rough regions seem preferable. Even when directed to them by ants, collecting of this species is slow and tedious. By actual count only five mature specimens were taken in three afternoons collecting, on mature trees. Quite by accident I chanced to stop to examine some small seedlings not more than 3 feet high and found that they had fairly large colonies of oviparous females and males on the trunks, not more than a foot from the ground. If this represents the normal preference for this species, perhaps it explains why this species is so rare in aphid collections.

APTEROUS MALE

Size and general color.—In life black, very insignificant looking, being much shrunken and very shriveled. Mounted specimens, after clearing and relaxing, vary in length from 2.07 to 2.50 mm. Mounted specimens have the head and thorax dusky brown, abdomen greenish with large lateral dusky areas; dorsum of abdomen with many dusky spots, which vary greatly in size and shape. Posterior region of abdomen dusky; cornicles dusky; antennae with the exception of the base of third dark dusky brown; femora brown at base shading to almost black; tibiae and tarsi uniform dark brownish black.

Head and appendages.—Width of head across eyes .715–.78 mm. Anterior margin of head rather flat with numerous long hair; median suture present; first and second antennal segments with numerous short, rather thick hair. All antennal segments imbricated; hair on antennal segment III, IV, and V spinelike and for the most part about as long as width of segment. Secondary sensoria distributed as follows: III, 10–39; IV, 0–2; V, 1–6. The specimen that had the fewest sensoria on III had the most on V. Marginal sensoria on VI far removed from primary, rather large, sometimes difficult to determine, most commonly three. Proportional lengths of antennal segments as follows: III, .715–.815 mm; IV, .314–.371 mm; V, .30–.343 mm; VI, .143 + .085–.185 + .128 mm. The unguis is outstandingly long and thick. Ocular tubercles present, well developed. The rostrum reaches almost to the cornicles.

Thorax and abdomen.—The hind tibiae measure 2.28–2.41 mm in length. The hind tarsi are .347 mm long. The hair on the hind tibiae is about equally well developed on all surfaces, in length it is subequal to the width of segment. The ventral surface of the first segment of the hind tarsus has about 15 hairs, the dorsal surface 3. The cornicles measure .171–.214 mm at the base, which is rather irregular in outline. The cauda and anal plate are rounded. The hair on these structures and on the cornicles is longer than that found on other parts of the body. The gonapophyses have what appear to be tufts of hair at their ends.

APTEROUS VIVIPAROUS FEMALE

Size and general color.—Length varying from 3.50 to 3.78 mm. Immature specimens of this species are so large that they may be taken for adults in the field. Body highly arched and much inflated except in regions of spots which appear deeply pitted. Color of head and thorax light brown with a very scant amount of pulverulent matter. Abdomen the color of cocoa with a rather thick hoar-frost pulverulence covering all but the cornicles, which are dark brown, very small lateral tubercles and areas which surround them, which are also brown, and small rather deeply pitted areas arranged in four rows on the dorsolateral surface of the abdomen.

These areas, which appear to be glandular, are most likely not wax glands, being free from pulverulent matter. First and second antennal segments slightly darker than the head, third segment yellowish brown at base shading to dark dusky brown, remaining antennal segments dusky; femora brownish at base shading to very dark dusky brown if not black; tibiae almost uniform brownish black, tarsi the same. Mounted specimens may show dusky areas on dorsum of abdomen. When present, these are irregular in outline and variable in size.

Head and appendages.—Width of head across eyes .57 mm; antennal segments with the following proportional lengths: III, .71–.78 mm; IV, .30–.314 mm; V, .314–.347 mm; VI, .157–.171 + .114 mm. The unguis is very long and thick. The secondary sensoria are distributed as follows: III, none; IV, 0–2; V, 0; marginal sensoria on VI far removed from primary; first and second antennal segments with more hair than usual; antennal hair spinelike, not so long as width of segment; antennal segments imbricated; primary sensoria free from hair ring; rostrum nearly reaching to base of cornicles; ocular tubercles poorly developed; head with a median suture, which continues more or less on the segments of the thorax, never being complete on any one segment.

Thorax.—The metathoracic femora are much longer than those of the prothorax and mesothorax, measuring 1.64 mm in length; the hind tibiae are 2.86 mm long; the hind tarsi measure .34 mm in length. The hair on the tibiae are spinelike and arise from clear areas which stand out from the otherwise very dark color of the tibiae; hair on tibiae not as long as width of tibiae, not all of uniform length, longest hair dull at the tip; first segment of hind tarsi with nine hairs on ventral surface and three on dorsal.

Abdomen.—Cornicles with base varying from .257 to .286 mm; base very irregular in outline with about four rows of hair; abdomen with much hair; cauda narrow but deep, with two kinds of hair: long spinelike hair on the margin and short fine hair on the dorsum. Anal plate rounded.

INTERMEDIATE VIVIPAROUS FEMALE

It was this form that Wilson described. Specimens of this form resemble the viviparous females just described in color. They differ from such females in size, varying from 3.78 to 4.00 mm, in length of sixth antennal segment, which is shorter, .128 + .08 mm; the unguis is different in shape, not being so thick or so blunt.

The hind femora are much shorter, 1.35–1.43 mm, as are also the hind tibiae, 2.28–2.59 mm. The tarsi are also shorter, those of the metathorax measuring only .228 mm.; antennal segments III, IV, and V vary within the limits of those of the true apterous viviparous female. The sensoria on the antennae are also similar; sensoria on the hind tibiae are similar to those of the oviparous female; the cornicles have a wider base.

OVIPAROUS FEMALE

Size and general color.—Length from vertex to tip of anal plate 3.2–3.64 mm. Color much the same as that of apterous viviparous female. However, some specimens are more black than brown, and such lack pulverulence and have a dull appearance due to abundant hair. The head and prothroax of black specimens are often light brown; the body is not highly arched.

Head and appendages.—Ocular tubercles poorly developed; width across eyes .78–.85 mm; antennal segments with the following proportional lengths: III, .74–.85 mm; IV, .257–.286 mm; V, .57–.386 mm; VI, .157 + .085 mm or .158 + .128 mm; unguis not so thick as that of apterous viviparous female; rostrum not reaching cornicles, median suture on head and thorax similar to females described; secondary sensoria distributed as follows: III, 0; IV, 0–1; V, 0–2; when present small.

Thorax.—Hind femora long, 1.57–1.78 mm; metathoracic tibiae, 2.71–2.84 mm; hind tibiae not disfigured by sensoria; sensoria not limited to upper half but few are present below the middle. The sensoria are irregular in shape and size, rather abundant, and hardly tuberculate. They are sometimes very difficult to determine because of the dark color of the tibiae. The hind tarsi are .328–.347 mm long.

Abdomen.—Base of cornicles measuring from .286 to .371 mm; posterior portion of abdomen not drawn out.

Types.—Allotype apterous male, taken October 12, 1951. Morphotype apterous viviparous female, taken September 16, 1951 (no sensoria on tibiae). Morphotype apterous oviparous female, taken October 12, 1951. All types deposited in the United States National Museum.

ICHTHYOLOGY.—*Notes on the systematic status of four eel families.*[1]

WILLIAM A. GOSLINE, University of Hawaii. (Communicated by L. P. Schultz.)

Certain aspects of the classification of the eel families Derichthyidae, Simenchelidae, Ophichthidae, and Chilorhinidae are taken up here. The last is proposed as new.

DERICHTHYIDAE

The species *Derichthys serpentinus* was described by Gill (in Goode and Bean, 1895: 161, fig. 169), who erected a new genus, family, and the new order Carenchelyi for it. However, subsequent authors have been unanimous in placing the species with other eels in the order Anguillida (or Apodes). Regan (1912: 386) has tentatively placed *Derichthys* in the Congridae, but Trewavas (1932: 641) and Beebe (1935) have retained a separate family for it. In the above works on *Derichthys* two points of disagreement have arisen: (1) whether the premaxillaries are separate from the vomer or whether they are fused with it, and (2) whether the frontals are ankylosed to form a single bone or whether they are separated by suture.

The type of *Derichthys serpentinus* consists of a skull 14 mm long, branchial arches, suspensoria, and pectoral girdles. In the skull the premaxillaries are ankylosed to one another but at present are free from the vomer. Gill stated that the premaxillaries were separated from the vomer by a suture, and I see no reason to doubt this despite the descriptions and figures of both Trewavas and Beebe. In fact, still another rather indefinite suture can also be made out in the type between the vomer and ethmoid.

A more unique feature among eels than the relationship between the premaxillary, ethmoid, and vomer in *Derichthys* is the maxillary articulation. This, instead of being at least in part medially with the ethmoid, is entirely forward, the front end of the maxillaries riding on sockets at either end of the transverse, premaxillary plate (Trewavas, 1932: 641, fig. 2).

As to the frontals, in the type specimen of *D. serpentinus* they are definitely ankylosed as stated by Beebe (1935: 9), and not paired as stated for *D. kempi* by Trewavas (1932: 641). This discrepancy, remarked upon elsewhere (Gosline, 1951a: 201), has been resolved by a recent letter from Trewavas. She writes: "I have examined the type of *Derichthys kempi* (Norman) and find that I had not slit the skin far enough to expose the frontals properly. I have now made a bigger slit and lifted the muscles and their raphe from the bones and I find that the frontals are united."

Benthenchelys, placed by Fowler (1934: 267) and Beebe (1935: 3) in the Derichthyidae, appears to be a congrid. *Gorgasia*, also placed in the Derichthyidae by Meek and Hildebrand (1923: 133) and Beebe (1935: 3), seems to be more nearly related to *Heteroconger*, which again may provisionally be considered a congrid.

SIMENCHELIDAE

The anatomical characters of this family, based on *Simenchelys parasiticus*, have been treated by Gill (1890), Regan (1912: 381), and Jaquet (1920).

As in the Derichthyidae the two premaxillaries are ankylosed, but this premaxillary plate, the ethmoid, and the vomer are again united by suture (Fig. 1). However, unlike *Derichthys* the maxillaries articulate with both the premaxillary plate and the ethmoid. In fact the relationships of all these bones of the snout area are exactly the same as those illustrated for the larval *Anguilla* by Trewavas (1932: 640, fig. 1). I think it may be assumed from these bone arrangements in the above two families and in the larval *Anguilla* that the ankylosis of the two premaxillaries to one another takes place earlier in life and occurred earlier in eel evolution than the fusion that gave rise to the premaxillary-ethmovomerine plate.

Again the question of fused *vs.* paired frontals has arisen in the literature on *Simenchelys*. Regan has indicated that the frontals of the Simenchelidae are paired. However, Jaquet (1920: 14) states that the frontals are ankylosed, as indeed they are in National Museum specimens. Once again this dilemma has been resolved by Trewavas. She writes (*in litt.*): "In our collection there is one specimen (N. Atlantic) partially dissected and this was probably the source of Regan's information. There is a median ridge in the frontal region which Regan may have interpreted as a suture but I can find no separation of the two bones."

[1] Contribution No. 19, Hawaii Marine Laboratory.

The presence of scales in one of the two genera of Simenchelidae and the maintenance of the premaxillaries, ethmoid, and vomer as separate entities are certainly prinitive for eels. However, the small transverse mouth with its short, deep maxillaries and dentaries seems to be unique in the order; whether these structures are primitive or specialized seems impossible to determine.

OPHICHTHIDAE

The osteology of several Hawaiian genera of ophichthids has been recently discussed (Gosline, 1951b). The present section deals with *Echelus myrus* from the Mediterranean. In view of the peculiarities of this eel and of the fact that recognition or non-recognition of the family name Echelidae depends upon the systematic position of *E. myrus* (since this is the type species of *Echelus*), it will be described and figured in some detail.

External features.—Head and body elliptical in cross section, somewhat higher than broad; head and trunk shorter than tail. Dorsal and anal low, continuous around tip of tail, the dorsal beginning somewhat behind middle of the pectoral. Pectoral well developed, with 16 rays. Lateral line of body extending from in front of gill openings nearly to tip of tail, with about 137 pores. Gill opening wide, below pectoral base. Snout more or less acutely pointed, its length equal to about 2 eye diameters. Eye well developed, its posterior border slightly ahead of rictus. Lower jaw inferior. Lips without folds, the upper somewhat fringed just behind anterior nostril; both lips with innumerable microscopic papillae. Anterior nostril in a tube; posterior nostril opening partly on the lateral, partly on the lower surface of the upper lip, the lower opening caused by a flap which covers the anterior two-thirds of the lateral opening (Fig. 2a). The pore system differs from that of other ophichthids examined (Gosline, 1952b) in lacking postorbital pores, a posterior supraorbital pore, an interorbital pore on the middorsal line, and a transverse series across the nape (Fig. 2a). Teeth multiserial on dentaries, maxillaries, premaxillary plate (fused premaxillaries), and vomer. Teeth on maxillaries and dentaries all small, conical, blunt, and non-depressible; those on the premaxillary similar but slightly larger and with a single somewhat enlarged, fixed tooth behind; those on vomer still larger, granular, rising from a subovate plate which is broadest behind center. Color brown above, lighter below, with short, light bands on the head and several white spots on nape (these markings not indicated in Fig. 2a); dorsal and anal light anteriorly, with dark borders posteriorly.

Lateral-line canals.—The lateral-line canals of this species have been excellently described by Allis (1903: 131). Nothing need be added to this account except to point out that the course of these canals is about as in other ophichthids, even though several of the external pores found in other members of the family are not present in *Echelus*.

Jaw structure.—Lower jaw with the articular and angular fused as usually in eels. Premaxillaries ankylosed to one another and to the ethmovomer, the toothed surface of the premaxillary area forming an angle with the rest of the upper jaw (Fig. 2b). Anterior end of maxillaries articulating with the cranium at about the point of junction between the premaxillaries and vomer. Maxillary long, extending nearly to the articular-

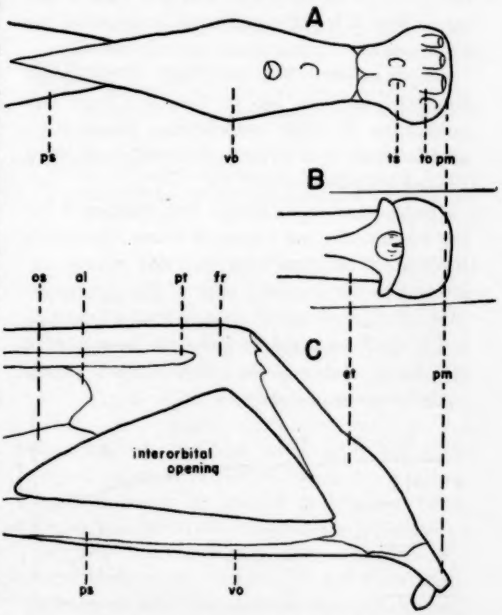


FIG. 1.—*Simenchelys parasiticus:* A, Ventral view of anterior end of skull; B, dorsal and somewhat anterior view of bones at tip of snout; C, lateral view of anterior end of skull; all ×7½. (al, Alisphenoid; et, ethmoid; fr, frontal; os, orbitosphenoid; ps, parasphenoid; pm, premaxillary plate; pt, pterotic; to, tooth; ts, tooth socket (its tooth missing); and vo, vomer.)

angular, to which it is closely attached by ligament, bearing multiserial teeth for nearly its entire length. There is a strong preorbital strut, apparently cartilaginous, between the maxillary and the cranium (Fig. 2b). In many, if not all eels in which the maxillaries are long and used for biting or crushing, a strut is developed between the maxillary and the cranium for support of the former. In the ophichthid *Brachysomophis* such a strut develops behind the eye from the postorbital lateral-line canal ossicles (Gosline, 1952b). The development of this strut in *Brachysomophis* has apparently pushed the eye far forward of its normal position in eels. In the muraenid *Gymnothorax funebris*, according to Fig. 82 of Gregory (1933: 202), both an antorbital and a postorbital strut are developed. Thus, maxillary supports of this type appear to be functional adaptations appearing here and there where needed among eels. However, the origin of the antorbital strut, where present, is dubious. That it is not an expanded lacrymal is indicated by its failure to bear any lateral line canal; that it is not a prefrontal is suggested by its apparently cartilaginous nature in *Echelus*.

Suspensorium.—This structure is somewhat forwardly inclined, less so than in *Conger* but more than in other ophichthids. Palatopterygoid laminar, well developed for eels, adjoining the quadrate posteriorly.

Opercular series.—Opercle well developed below but more or less truncated above. Preopercle moderately developed for eels and closely appressed to the posterior edge of the hyomandibular. Subopercle made up largely of a branchiostegal-like bone which encircles the lower edge of the opercle. Interopercle well developed, largely underlying the preopercle.

Gill arches.—Tongue not free. Branchiostegal rays 15 on each side, those of the two sides overlapping below. Openings between the gill arches wide, except the last. Upper pharyngeal ovate, with numerous conical teeth.

Cranium.—The skull of *Echulus* is long and moderately low, with an interorbital opening that is longer than deep. Unlike other ophichthids examined, the skull of *Echelus* is abruptly truncate posteriorly with a prominent edge above, as in *Conger*. There is a slight, longitudinal, median crest running along the ankylosed frontals. The ethmoid sends a triangular wedge over the anterior end of the frontals. A well-developed otic bulla present.

Axial skeleton.—On one of the first vertebrae (the only one examined) there is no neural crest. In this character *Echelus* like other ophichthids differs from the Congridae.

Pectoral girdle.—This structure, together with the pectoral fins, is fully developed for eels, with 4 well-formed actinosts.

Discussion of Echelus.—In that *Echelus myrus* bears a number of structures showing a closer resemblance than any other ophichthid to the relatively unspecialized Congridae (from which the Ophichthidae was undoubtedly derived), it may be said to be a primitive member of its family. Characters on which this statement is based are: suspensorium somewhat forwardly inclined; branchiostegal rays relatively few; skull abruptly truncate posteriorly; and pectoral girdle with four actinosts.

Characters in which *Echelus* appears to differ both from the Congridae and from other ophichthids are: external pores of the lateral line system of the head reduced in number; a middorsal crest on the skull; and an antorbital stay between the maxillary and the cranium.

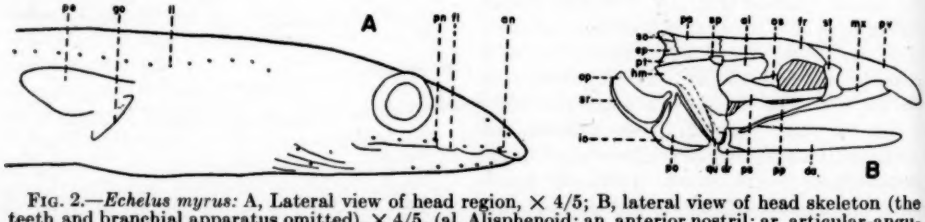


FIG. 2.—*Echelus myrus:* A, Lateral view of head region, × 4/5; B, lateral view of head skeleton (the teeth and branchial apparatus omitted), × 4/5. (al, Alisphenoid; an, anterior nostril; ar, articular-angular; da, dentary; ep, epiotic; fl, flap covering the anterior section of the posterior nostril; fr, frontal; go, gill opening; hm, hyomandibular; io, interopercle; mx, maxillary; op, opercle; os, orbitosphenoid pa, parietal; pe, pectoral fin; pn, posterior section of posterior nostril; po, preopercle; pp, palatopterygoid; ps, parasphenoid; pt, pterotic; pv, premaxillary-ethmovomerine plate; hu, quadrate; so, supraoccipital; sp, spenotic; sr, subopercle; and st, preorbital strut.)

Characters in which *Echelus myrus* is similar to other ophichthids but differs from *Conger* are as follows: posterior nostril opening out on the ventrolateral surface of the upper lip; tongue not free; branchiostegal rays of the two sides overlapping along the midventral line; otic bulla developed; and neural crests apparently absent.

In summary, *Echelus myrus* appears, despite specializations, to be by far the most primitive (or generalized) ophichthid known. In fact, to a considerable degree it fills in the gap between the Ophichthidae and the Congridae.

Within the Ophichthidae, on zoological grounds as well as for convenience in identification, two subfamilies should in my opinion be recognized: (1) the Echelinae (called Myrophinae by Gosline in previous papers) with the dorsal and anal continuous around the tip of tail, and (2) the Ophichthinae with the tail protruding as a fleshy point. Both of these subfamilies contain very diverse eels and both include highly specialized members, but there is no known evidence that either is polyphyletic. Because of this diversity, the separation of *Echelus*, despite its peculiarities, from other fintailed ophichthids—*Muraenichthys*, *Myrophis*, etc.—as a third subfamily seems inadvisable at the present time.

CHILORHINIDAE, n. fam.

The family name Chilorhinidae is here proposed for a group of three eel genera: *Chilorhinus* Lütken (1851), *Garmanichthys* Seale (1917, of which *Arenichthys* Beebe and Tee-Van, 1938, appears to be a synonym), and *Kaupichthys* Schultz (1943). These three genera have generally been placed with *Echelus*, *Muraenichthys*, etc., in the family Echelidae. However, osteological investigation has shown that *Kaupichthys* (Gosline, 1950) and *Chilorhinus* (Gosline, 1951a) belong in a very different family from *Muraenichthys* (which is an ophichthid, Gosline, 1951b). At the time the above genera were investigated specimens of *Echelus* were unavailable to me, and the name Echelidae was provisionally retained for the family represented by *Kaupichthys* and *Chilorhinus*. That this use of the name Echelidae is untenable has been shown by the previous section of the present paper. The name Chilorhinidae is therefor substituted.

Examination of a specimen of *Garmanichthys apterus* indicates that this genus also belongs in the Chilorhinidae.

Though phylogenetically distant as has been previously pointed out, the chilorhinids bear a close superficial resemblance to the subfamily Echelinae of the Ophichthidae. The two groups can, however, be separated by a few minor superficial characters which may be tabulated as follows:

CHILORHINIDAE	ECHELINAE
Branchiostegal rays of the two sides (usually visible through the flesh of the "neck") never overlapping on the midventral line.	Branchiostegal rays of the two sides overlapping on the midventral line.
Vomerine teeth biserial, the two rows widely separated.	Vomerine teeth, if present, uniserial, in two or more irregular rows, or in a broad band.
Fin rays at the tip of the tail longer than the dorsal and anal rays preceding them.	Fin rays at the tip of tail usually shorter than the dorsal and anal rays preceding them.

The three known genera of Chilorhinidae may be separated as follows:

1*a*. Pectorals present, well developed (Indo-West-Pacific) ..... *Kaupichthys*
1*b*. Pectorals rudimentary or absent.
  2*a*. Lower lip with a well-developed flap on either side; snout broader than long (West Indies and Hawaii) ..... *Chilorhinus*
  2*b*. Lower lip without a downwardly-folded flap on either side; snout longer than broad (includes *Arenichthys;* both sides of tropical America) ..... *Garmanichthys*

EEL CLASSIFICATION

Recent examination of the osteology of certain eels (Gosline, 1950, 1951a, 1951b, and the present paper) has necessitated a shift in the systematic position of several eel families. Yet much remains to be done before any basic understanding of eel classification can be attained. Not only are we ignorant of the phylogenetic relationships of many eel groups and of the order Anguillida itself, but the present delimitation of many eel families is awry. On the one hand families have been erected for certain species on insufficient osteological evidence; on the other the Congridae continues to form a dumping ground for all sorts of creatures (including, as my contribution, *Benthenchelys*, *Gorgasia*, and the Macrocephenchelidae). At present then, it is impossible to do more than add to the classification of eels set up by Regan (1912).

So far as I can tell, this foundation remains sound; at the very least, a better one has never been proposed. The changes in classification necessitated by the recent work cited above can be integrated into the synopsis of eel families given by Regan (1912: 379) and amended by Trewavas (1932: 656) as follows:

1*a*. Caudal fin well developed and free from dorsal and anal. (A fossil group.) ..... URENCHELIDAE
1*b*. Caudal fin, if present, small, and generally continuous with the dorsal and anal.
2*a*. Frontals divided by suture, at least posteriorly.
3*a*. Frontals divided by a suture for their entire length.
4*a*. Jaws not produced.
5*a*. No expanded auditory bulla present ANGUILLIDAE, XENOCONGRIDAE, MYROCONGRIDAE, and MURAENIDAE
5*b*. Prootic and basioccipital forming an enlarged auditory bulla around a large otolith.
6*a*. Posterior nostril labial CHILORHINIDAE
6*b*. Posterior nostril on cheek HETERENCHELIDAE and MORINGUIDAE
4*b*. Jaws produced ..... SERRIVOMERIDAE
3*b*. Frontals ankylosed anteriorly NEMICHTHYIDAE and CYEMIDAE
2*b*. Frontals ankylosed for their entire length.
7*a*. Maxillaries articulating only with lateral tips of premaxillaries .... DERICHTHYIDAE
7*b*. Maxillaries articulating in part or entirely with ethmoid.
8*a*. Jaws strong; suspensorium vertical or directed obliquely forward.
9*a*. Caudal vertebrae without transverse processes above haemal arches.
10*a*. Maxillary articulating with ethmoid at some distance from end of snout ..... MURAENESOCIDAE and NEENCHELIDAE
10*b*. Maxillary articulating with ethmoid near tip of snout.
11*a*. Mouth a small, transverse slit across front of head SIMENCHELIDAE
11*b*. Gape large; jaws long NETTASTOMIDAE and NESSORHAMPHIDAE
9*b*. Caudal vertebrae with transverse processes above the haemal arches.
12*a*. Posterior nostril superior or lateral. (The Heterocongridae and Macrocephenchelidae are provisionally included here.) ..... CONGRIDAE
12*b*. Posterior nostril labial. (Includes Echelinae.) ..... OPHICHTHIDAE
8*b*. Jaws slender; suspensorium directed obliquely backward ..... ILYOPHIDAE, DYSSOMIDAE, and SYNAPHOBRANCHIDAE

I wish to thank Dr. L. P. Schultz for permission to examine skeletal material in the U. S. National Museum of *Simenchelys* and *Derichthys* reported on by Gill (1890 and, in Goode and Bean, 1895, respectively), together with a preserved specimen of *Garmanichthys apterus*. Through the kindness of Dr. G. S. Myers and J. Böhlke, a Stanford University specimen of *Echelus myrus* has been lent me; as this appears to be the only specimen of *Echelus* in America, I am particularly indebted to Dr. Myers for permission to dissect it partially. I also wish to thank Dr. E. Trewavas of the British Museum for examining specimens of *Derichthys* and *Simenchelys* for me.

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PROCEEDINGS OF THE ACADEMY

452D MEETING OF BOARD OF MANAGERS

The 452d meeting of the Board of Managers held in the Cosmos Club on January 14, 1952, was called to order at 8:03 p.m. by President-Elect WALTER RAMBERG. Others in attendance were: H. S. RAPPLEYE, J. A. STEVENSON, H. A. REHDER, CHARLES DRECHSLER, W. F. FOSHAG, A. T. MCPHERSON, C. F. W. MUESEBECK, SARA E. BRANHAM, J. J. FAHEY, E. H. WALKER, WM. A. DAYTON, C. A. BETTS, R. S. DILL, A. M. GRIFFIN, FLOYD HOUGH, M. A. MASON, F. M. DEFANDORF, and, by invitation, MARGARET PITTMAN, J. R. SWALLEN, G. P. WALTON, B. D. VAN EVERA, and G. H. COONS.

Chairman WALTON presented the report of the Committee on Awards for Scientific achievement. MILTON SEYMOUR SCHECHTER, of the Bureau of Entomology and Plant Quarantine, was nominated for the Award in the Physical Sciences; EDWARD WILLIAM BAKER, Bureau of Entomology and Plant Quarantine, for the Award in the Biological Sciences; and MAX A. KOHLER, of the Weather Bureau, for the Award in the Engineering Sciences. For the Teaching of Science, the first award of its kind to be requested of the Board since this award was approved in principle in 1950, the Committee recommended that in lieu of the regular award, which bears the age limitation of 40, a special award be presented to HOWARD B. OWENS, biology teacher in the Hyattsville High School, for his outstanding teaching and for his work in arousing the enthusiasm of the students who come in contact with him. The Managers approved the granting of the awards as recommended.

Chairman MASON of the Committee on Encouragement of Science Talent spoke of activities in connection with the forthcoming 4th District Talent Search, the National Science Talent Fair, and the 5th Annual Science Fair to be held in Washington. Funds accruing from the Academy-sponsored benefit showing of the film Kon-Tiki should ease the financial problems that arise on these occasions where there is no obvious source of financial support.

The Secretary read a letter dated January 4, 1952, from N. R. Ellis, secretary-treasurer of the Society for Experimental Biology and Medicine, expressing the interest of this Society in becoming affiliated with the Academy. It was moved and approved that the President of the Academy appoint a special committee to consider the application and bylaws of the Society and make suitable recommendations to the Board.

The Secretary read a letter from the business manager of the American Association for the Advancement of Science, listing the following amounts available for Grants-in-Aid:

Balance for 1950	$4.50
For 1951	249.00
For 1952	246.00

making a total presently available of $499.50. The small amount remaining for 1950 will not be available unless expended before December 31, 1952.

Deaths were reported of OSCAR B. HUNTER, SR., on December 19, 1951. and RUFUS H. SARGENT on December 28, 1951.

On request and recommendation of the Treasurer, BERTRAND L. JOHNSON, who will retire in 1952 from the U. S. Bureau of Mines, was transferred to the retired list as of December 31, 1952.

Letters of resignation were received from MAXWELL M. KNECHTEL, WILLIAM VOGT, and L. E. WHITTEMORE. Their resignations were approved as of December 31, 1951.

The Treasurer reported that his books had been audited for 1951 and the securities had been examined by the auditing committee.

Senior Editor Drechsler gave a statistical report on the content of the 1951 volume of the JOURNAL and indicated that the net cost would be $6,500.76.

The meeting was adjourned at 9:15 p.m.

F. M. DEFANDORF, *Secretary*

Obituary

MAURICE ISADORE SMITH was born November 17, 1887, in Russia and became a naturalized citizen of the United States at the age of 10. He attended school in New York, receiving his B.S. degree from the College of the City of New York in 1909. From there he went on to study medicine at Cornell University Medical School and obtained his medical degree in 1913. His early professional experience was in teaching, first as instructor of pharmacology at the University of Michigan and later as professor of pharmacology at the University of Nebraska.

In 1920, Dr. Smith joined the staff of the pharmacology division of the Hygienic Laboratory (the present National Institutes of Health) of the Public Health Service. Thereafter, except for a brief period as director of the Glandular and Pharmaceutical Department of Lederle Antitoxin Laboratories, Dr. Smith devoted his entire professional career to Government service. Judged by the number and quality of his publications over a period of 30 years, he found it a satisfying and productive field of labor. During the greater part of this time, Dr. Smith served as physiologist representative on the Basic Science Board of the Commission for Medical Licensure of the District of Columbia, giving to this activity the same conscientious devotion he gave to his research projects.

Aside from the high quality of Dr. Smith's work in the field of pharmacology, one is impressed by his versatility. In addition to pharmacological and closely related studies we find him contributing to advancement in the field of surgical shock, the sulfones, drug standardization, selenium toxicology, chemotherapy, vitamins, antibiotics, and tuberculosis. Perhaps the best example of Dr. Smith's interest in different fields of research is to be found in his work on Jamaica-ginger paralysis, the "jake paralysis" that afflicted many thousands of people in midwestern and southwestern States early in 1931. After his studies had shown that this condition was due to one of the several esters of tricresyl phosphate contained in an adulterated extract of ginger sold for beverage purposes, the investigation led him directly into the field of epidemiology. He made a trip into the geographic area where there was a particularly well defined outbreak of the disease and made an investigation of an epidemiological character that would have done credit to the scientist specializing in epidemiologic studies.

During the last decade of his professional career, Dr. Smith's chief interest was the chemotherapy of tuberculosis. His research in this field dates back to 1922 with the publication of several papers on the chemotherapy of acridine dyes; in 1940 he initiated an extensive program in the development of new sulfone derivatives for treatment in experimental tuberculosis. With the development of streptomycin he undertook a series of studies in which it was demonstrated that combined therapy with a sulfone gave potentiation to tuberculostatic action. In addition he carried on a series of studies on the metabolism of the tubercle bacillus and the problem of acquired resistance during treatment. The literature on the chemotherapy of tuberculosis is substantially enriched by the many contributions prepared and directed by Dr. Smith.

His range of interests is reflected in the number of scientific societies of which he was a member—among others the American Association for the Advancement of Science, Society for Experimental Biology and Medicine, Trudeau Society, Society of Pharmacology and Experimental Therapeutics, Physiological Society, and the Washington Academy of Sciences.

Those who knew Dr. Smith best would agree that he was a careful, gifted scientific worker, an inspiring teacher, a faithful, devoted public servant, a helpful friend, and a stimulating associate.

Dr. Smith died on January 26, 1951. He is survived by his widow, Mrs. Rebecca M. Smith, of Bethesda, Md., and two sons, Dr. Charles E. Smith, of the U. S. Public Health Service, and Matthew S. Smith, a graduate in engineering specializing in the field of aeronautical design.

GEORGE W. MCCOY